# Electronics & Technology Today

$3.50
MM70924
AUG 89

Canada's Magazine for High-Tech Discovery

# Video!

## New developments and techniques
## Video Still Cameras
## The Future of Video

PLUS
Capacitor Tester
Signal Tracer

## Hitachi's VM-6100A


08
0 57438 70924 1

513735*JAN 90* ET03* *
KEVIN JOURNEAUX
68 EASTON AVE
MONTREAL WESTPQ H4X 1K8

VISIT OUR SHOWROOM AT 321 COLLEGE ST., TORONTO

# THE BES

## Designed and Made i

## BEST COMPACT 386SX

This newest addition to our computer line features the Intel 80386 SX 16 MHz microprocessor which uses a 16 bit external bus similar to the 286 AT compatible machines. However internally the 32 Bit 386-SX microprocessor is compatible with that of a 80386 processor. Socketed for optional 80387SX co-processor. Features 1 MB onboard RAM (optionally expandable onboard to 2MB and 4 MB RAM). Processor speed 16 MHz (switchable to 8 MHz), 8 expansion slots, Two serial ports, one parallel port, real time clock, one 1.2 MB floppy disk drive (optionally available with 5.25" 360K or 720K 3.5" floppy disk drive), 101 enhanced keyboard. Features a small footprint, yet it can take as many cards and drives (including hard drives) as full-sized models.

**Since this machine has such extraordinary performance at such a low price, we believe it represents the best value in the market today.**

## BEST COMPACT 386-16

(16 MHz, 8-slot 386 System)

Based on the Intel 80386 microprocessor, Phoenix BIOS, One 1.2MB Floppy Diskette Drive (Optional 360K 5.25" Floppy Drive or 720K 3.5" Floppy Drive or 1.44MB 3.5" Floppy Drive), socketed for 80387 math co-processor, 8 Expansion Slots, Two Serial Ports, One Parallel Port, Real Time Clock, Floppy Controller and Hard Drive Controller, 101 Enhanced Keyboard. Available with 32-bit memory in the following RAM configuarations: 2 Mb, 4MB, 8 MB, 16 MB. Features a small footprint, yet it can take as many cards and drives (including hard drives) as full-sized models.

Also available

**COMPACT 386-20**

a 20MHz version of the above configuration.

## BEST PERFORMER 86 10-3

(10 MHz, 3-slot XT Compatible)

Based on the 16-Bit 10MHz 8086 microprocessor, Phoenix BIOS, Available with one 360K 5.25" Floppy or up to two 720K 3.5" Floppy Diskette Drive, socketed for 8087 math co-processor, 640K RAM, 3 Full-Length XT Expansion Slots, Two Serial Ports, One Parallel Port, Real Time Clock, Also features On-Board Hercules Compatible Display Adapter, Floppy Controller and SCSI Hard Drive controller, key lock for system and case, 101 Enhanced Keyboard.

Optional extras include 20 MB SCSI Hard Drive or 40MB SCSI Hard Drive.


**WARR**

All Exceltronix **BEST** c
One Year Warranty a

**Exceltronix**

Circle No. 1 on Reader Service Card

# HOW TO GET MORE INFO

**For more information on any of the companies advertised in this issue, use the Electronics & Technology Today Reader Service Card.**

## Here's how it works:

Each ad - and each product listed in the *For Your Information* and *New Products* sections - has a unique Reader Service Number.

Make a note of the number for each of the companies you are interested in...

You'll find the Reader Service Card bound into your copy of Electronics & TechnologyToday. Circle the appropriate numbers on the card, fill in the simple questionnaire (don't forget your own address!), and send it off.

A copy of your request is forwarded to each of the respective companies - who will be more than happy to respond to your interest by sending you a full information package.

**Use our card to get the Whole Story**

---

*Electronics & Technology Today*

**READER SERVICE CARD**
May 1989

Card void 6 months after issue date

**Circle the appropriate Reader Service number below for more information, the advertiser will send you further literature free of charge. PLEASE PRINT.**

NAME: John Smith

TELEPHONE: (319) 591-7840

STREET: Mainstreet

CITY/TOWN: Cityville

PROVINCE Alberta ........ POSTAL CODE M46-5A4

COMPANY NAME: ABC Design

**JOB FUNCTION (CHECK ONE)**

- ☑ Corporate Management
- ☐ Operational Management
- ☐ Computer Systems Management
- ☐ Financial Management
- ☐ Education
- ☐ Technology
- ☐ Consultant
- ☐ Marketing

**TYPE OF INDUSTRY (CHECK ONE)**

- ☐ Government
- ☐ Education
- ☐ Finance
- ☐ Computer Industry
- ☑ Construction
- ☐ Medical/Legal
- ☐ Manufacturing
- ☐ Other

**I have recently purchased the following products after reading about them in Computing Now!:**

SYSTEM 2000/386 ........ $ 3,000

........................................ $ ..........

**Where product purchased** ........................................

**Do you subscribe to Computing Now!** Yes ☑ No ☐

**Complete below if you wish to take out a subscription:**

- ☐ One year $22.95 ☐ Two years $37.95
- ☐ Bill me (subscription will start once payment is received)
- ☐ I enclose my cheque (send with card in envelope)
- ☐ Visa ☐ MasterCard ☐ Amex

Card No ........................ Card Expiry Date ............

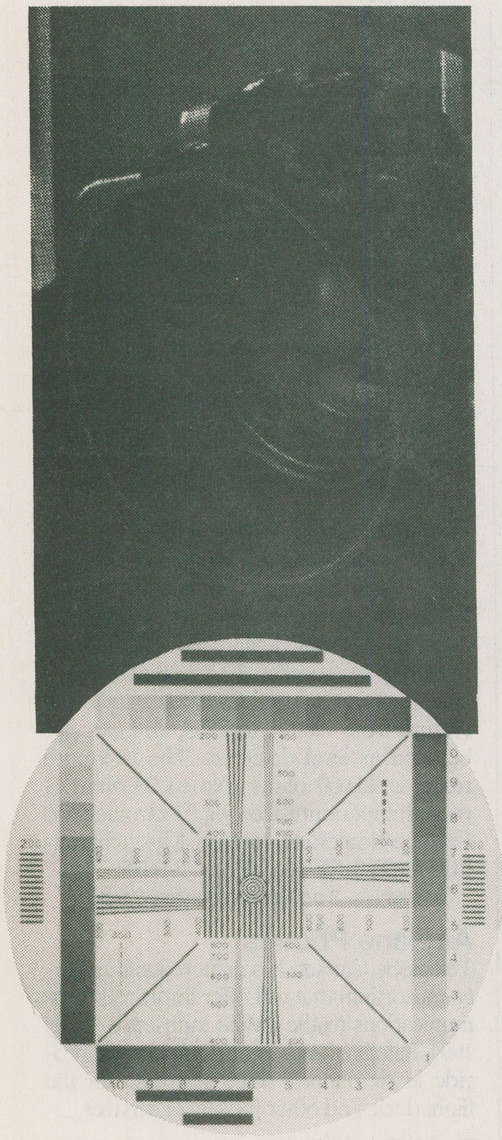
**Circle the Reader Service Card Numbers for the items in which you are interested.**

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |

**Electronics & Technology Today**

Canada's Magazine for High-Tech Discovery

Volume 13, Number 8 August, 1989



# FEATURES



# TECHNOLOGY



# PRODUCT REVIEW



# PROJECTS



# INFORMATION

**Electronics & Technology Today**

**Electronics & Technology Today**
is published 12 times a year by:
Moorshead Publications Ltd.
1300 Don Mills Road, North York, Ontario
M3B 3M8 (416)445-5600 FAX: (416)445-8149

| | |
|---|---|
| Editor: | William Markwick |
| Director of Production: | Papu Leynes |
| Art Direction: | Kevan Buss |
| Circulation Manager: | Sharon Cernecca |
| Advertising Representative: | Richard Maharaj |
| President: | H.W. Moorshead |
| Publisher & Executive Vice-President: | V.K. Marskell |
| Vice-President—Sales: | A. Wheeler |
| Vice-President—Finance: | B. Shankman |
| Production Assistants: | C. Dalziel |
| Office Manager: | P. Dunphy |
| Reader Services: | R. Cree |
| | J. Cardoni |
| Advertising Services: | M. Millett |
| | H. Brooks |

**Newsstand Distribution:**
Master Media, Oakville, Ontario

**Subscriptions:**
$22.95 (one year), $37.95 (two years).
Please specify if subscription is new or a renewal.

Outside Canada (US Dollars). U.S.A. add $3.00 per year. Other countries add $5.00 per year.

Electronics & Technology Today
is indexed in the Canadian Magazine Index
by Micromedia Ltd.
Back copies are available in microfilm form
from Micromedia Ltd. 158 Pearl Street,
Toronto, Ontario M5H 1L3 (416)593-5211.

**Printed by:**
Heritage Press Ltd., Mississauga, Ontario

ISSN 07038984

Moorshead Publications also publishes PETS Magazine, Computing Now!, Computers in Education, Business Computer News and Government Purchasing Guide.

Circulation independently audited by
MURPHY & MURPHY Chartered Accountants.

**Postal Information:**
Second Class Mail Registration No. 3955.
Mailing address for subscription orders, undeliverable copies and change of address notice is:
**Electronics & Technology Today**
1300 Don Mills Road, North York, Ontario
M3B 3M8.

# FOR YOUR INFORMATION



**LIABILITY**
No responsibility whatever is accepted for failure of projects to perform for any reason, and no responsibility is accepted for any injury or damage caused by any fault in design.

**EDITORIAL QUERIES**
We cannot answer telephone queries. Written queries must be accompanied by a stamped, self-addressed envelope, relate to recent articles and must not involve the staff in any research.

**PCB SUPPLIERS**
We do not supply printed circuits or kits, and we do not keep track of availability. However, PCBs for projects are available from the following mail order sources:
**B-C-D Electronics**, PO Box 6326, Stn. F., Hamilton, Ontario L9C 6L9.
**K.S.K. Associates**, PO Box 266, Milton, Ontario L9T 4N9.
**Spectrum Electronics**, 14 Knightswood Crescent, Brantford, Ontario N3R 7E6.

## Computer Fest

Computer Fest, Canada's biggest show for the computer consumer, returns to Exhibition Place in Toronto, Oct. 13-15. Over 70 exhibitors will attend, selling a wide variety of hardware and software. Expected attendance is 15,000. Tickets are available for $6 at the door of the Arts Crafts Hobbies Building just inside the Dufferin entrance, starting at Friday noon.

## Audio Switch IC

Precision Monolithics has introduced a low-distortion, clickless "T" IC switch for professional audio use. The SSM-2402 offers improved performance over CMOS analog switches or discrete FET circuits; distortion and noise are negligible over the range 20-20kHz and up to 10Vrms signal swing. The inputs and outputs are protected against overload and overvoltage and a low impedance load may be switched without buffering. From PMI dealers, or contact them at 1500 Space Park Drive, PO Box 58020, Santa Clara, CA 95052-8020, (408) 727-9222, Fax 727-1550.

Circle No. 2 on Reader Service Card

## Cryogenic Thermistors

If you work with liquid oxygen or nitrogen (as you would in superconductor research), Fenwal Electronics offers the Glass-Encapsulated Parallel-Matched NTC Thermistor, part number 129- 200ZDW-Q01. The units can be used for measuring temperature from -200°C to 25°C, and can also be used as level detectors. The resistance range is 40,000 ohms cold to 20 ohms at room temperature. Fenwal Electronics, 450 Fortune Boulevard, Milford, Massachusetts 01757, (508) 478-6000, Fax 473-6035.

Circle No. 3 on Reader Service Card

## Airplane Phones

Teleglobe Canada has enetered a four-party consortium that will offer improved communications to the airline industry by early 1991. Satellites and ground stations will provide in-air phones, voice and data for the flight deck, and other passenger services.

## Fast Rectifiers

If you've ever made or repaired a high-speed switching supply by using standard power diodes, you probably noticed the saggy waveform produced by the slow risetime. Motorola offers the solution with their MUR870E, 880E, 890E, and 8100E fast-recovery power diodes. The voltage ratings are, respectively, 700, 800, 900 and 1000 volts, with a recovery time of 75ns. The 8A average current and TO-220 package make them ideal for switching applications. From your local Motorola dealer.

## LCR Bridges

Prism Electronics of the UL present three LCR Databridges, each having L,C, or R measurement using an automatic or manual selection mode. Displays are 4-digit LEDs with autoranging.

The Model 6401 has an 8-decade range, and accuracy of 0.25% and a wide rnage of options. The Model 6421 has 11 decades, 0.2% and an optional IEEE-488/RS232 interface plus grading software. The Model 6451 adds a range of 11 decades and an accuracy of 0.1%. Duncan Instruments, 121 Milvan Drive, Toronto, Ontario M9L 1Z8, (416) 742-4448.

Circle No. 4 on Reader Service Card

## Relay Catalog

Philips ECG is offering their 115-page catalog, Relays and Accessories. There are more than 300 types of relays listed, including general-purpose, time-delay, reed, PC-mount, solid- state and more. Also included is a two-part cross-reference which crosses over 12,000 part numbers. ECG Canada Inc., 1928 St. Regis Boulevard, Dorval, Quebec H9P 1H6, (514) 685-5800, Fax 685-5804.

Circle No. 5 on Reader Service Card

## New Audio Generator

B&K Precision announces a new pocket-sized audio generator, the Model 3001. The low-cost, 20Hz-150kHz unit is ideal for field service or hobbyist troubleshooting applications. weighing only 7 ounces, the 3001 has a sine or square output. Atlas Electronics, 50 Wingold Ave., Toronto, Ontario M6B 1P7, (416) 789-7761, Fax 789-3053.


Circle No. 6 on Reader Service Card

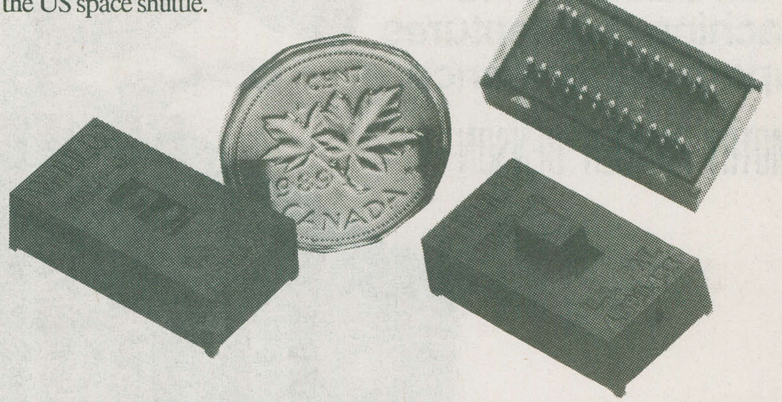
## Canada In Space

The Canadian Space Agency in Montreal will direct a budget of $3 billion to the end of the century, and comprises the executive, administrative and most research functions for the Space Station, RADARSAT, Astronaut and European Space Agency programs. Canada will draw on its remote-manipulator experience to provide materials handling capability for the Freedom Space Station, planned for completion in the 1990s after about 20 supplying flights by the US space shuttle.

## Byte-Wide Switch

The Annulus HDMP-8 is an 8PDT snap action switch with gold-plated elliptical contacts. It can be used for routing a digital byte or up to eight analog channels. It's available with either a knob actuator or a screwdriver slot. Annulus Technical Industries, PO Box 7407, 1296 Osprey Drive, Ancaster, Ontario L9G 4G4, (416) 648-8100, Fax 648-8102.

Circle No. 7 on Reader Service Card







Circle No. 8 on Reader Service Card

REVIEW

# Hitachi VM-6100A Camcorder


## A full-sized S-VHS machine that features superb performance.

TIMOTHY PALMER-BENSON

The Hitachi VM-6100A is a full size S-VHS camcorder that bucks the trend towards midget size. This is one of the biggest consumer camcorders of the market. It is 15 and a half inches long and weighs 2.5 kg or 5.5 lbs. Some people will undoubtedly think twice before taking it on a trip; on the other hand, the disadvantage of its balkiness is offset by its performance. My lab tests have proved that this is one of the finest S-VHS camcorders available when it comes to sheer video quality.

The VM-6100A does not come with a lot of frills but nonetheless is expensive. Its suggested list price is $2,399.00. The unit records and plays at a single speed - SP. Most of its features are standard, such as a 8:1 two-speed power zoom lens with macro capability and infrared focus. The camcorder has time and date stamping and four additional electronic shutter speeds of 1/120th, 1/1250th, 1/100th and 1/1200th as well as the standard 1/60th speed. Speeds are displayed in the viewfinder. Faster shutter speeds are useful for capturing high speed movement such as horse racing, tennis and golf shots.

The three major camera functions can be switched to automatic. Thus one can point and shoot; the camera adjusts white balance, exposure (iris) and focus automatically. Automatic level control is used for audio which is recorded on the standard longitudinal track from a microphone that attaches to the electronic viewfinder assembly. A switch next to the microphone can be set to filter out the effects of wind noise. An A/V output jack on the side of the unit provides S-VHS video output via an outboard adapter. Leads from this video adapter give you the choice of separate luminance and chrominance or composite video.

Lab tests were conducted for color accuracy, resolution, white balance tracking, grey scale compensation and smear using professional grade equipment. This included a special light box made by Sony which was calibrated to 3200 degrees Kelvin. The light box is equipped with an EIAJ color bar chart, an EIAJ resolution chart and an EIAJ 11-level chip moustache grey scale chart. Leader's new Vector/Waveform monitor, the model 5870, was also used for testing as well as a high resolution monitor equipped with an S-VHS input.

On the color bar test, red and green showed up with no error on the vectorscope, while blue was off by -10 degrees. The results were the same live and off tape. Live resolution checked out at 390 lines, which is very close to the ideal 400 lines of the S-VHS format. The same excellent results were obtained off S-VHS tape. When normal VHS tape was used, resolution fell to 240-lines, which is still respectable. On the grey scale test, the Gamma reading was right at 55 IRE (Institute of Radio Engineers) of the waveform monitor indicating correct compensation.

For those unfamiliar with the grey scale test, it is performed because television picture tubes are non-linear. Greys are apt to appear darker than normal and average whites are apt to appear whiter than normal. In order to compensate for this non-linearity, all video signals are intentionally pre-distorted at the camera. Blacks are made to look like grays and extreme white is made to look like average white. A grey scale chart is used to check whether the camera is adjusted correctly for this "pre-distortion" which in engineering parlance is called Gamma Correction. The correct Gamma reading with a camera pointed at an EIAJ 11-step grey scale chart should be 55 IRE which as noted before is the case with the Hitachi (see Fig.1).

The VM-6100A also did well on the smear test (see Fig.2). All modern camcorders convert light into electricity by means

of thousands of tiny photo-electric cells mounted on a chip behind the lens. These cells or pixels are arranged in vertical or horizontal arrays. When a group of pixels is exposed to light, an electrical charge is generated. The amount of light determines the charge. The charge is then stored in a well, formed within the cell. From here, the charge is transferred to a another group of cells that made up of tiny metal oxide silicon capacitors (MOS). These cells are shielded from the light and are known as a vertical and horizontal shift registers. Their function is to transfer the charge from the wells formed in the pixels to the video camera's processing circuitry. The average camcorder uses around 250,000 pixels; however, it is not really the number of pixels that count but rather how the overall system reacts to light. Some camcorders produce mysterious vertical bars or smearing when they are aimed at a bright light. The amount of smearing depends on the design and construction of the shift registers and photo- electric cells. In the case of the Hitachi unit no vertical bars were visible, which means you can point the camcorder at bright reflections such as a chrome bumper or street lamps and not get vertical bars running down the picture.

The Hitachi exhibits one noise bar in still frames, while review showed two noise bars with some jitter. Forward review showed one noise bar at the top of the screen with some jitter. Fast forward time for a T-120 was seven minutes and seven and a half minutes for fast rewind. These are average results for a full size camcorder; however, I do not regard them as critical to the operation of the unit. Anyone prepared to spend the kind of money being asked for this unit is likely to be already heavily into video and will doubtless have a home VCR that provides noiseless still frames and other special effects at the drop of a hat.

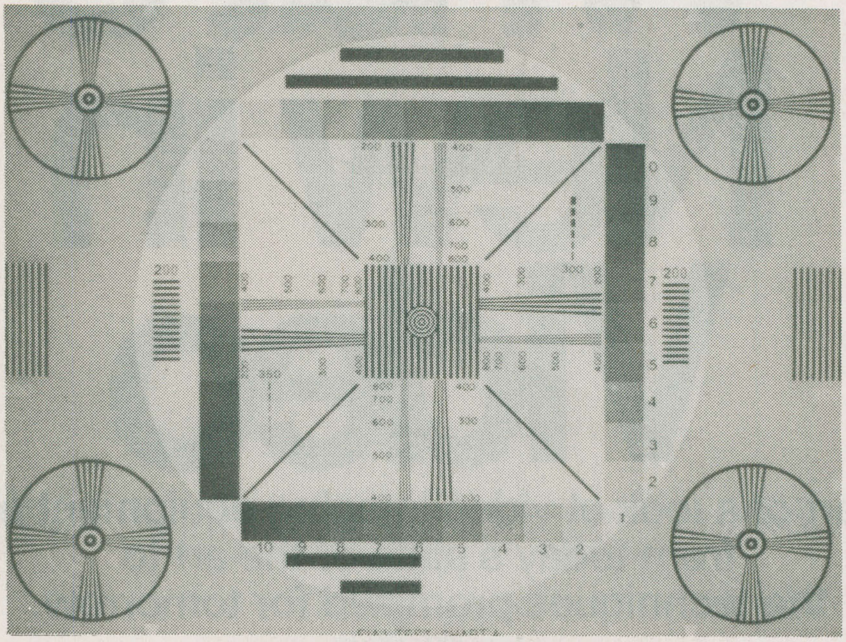


*Fig. 1. The Hitachi VM-6100A produced a resolution of 390 lines, close to the ideal 400 lines of the S-VHS format.*

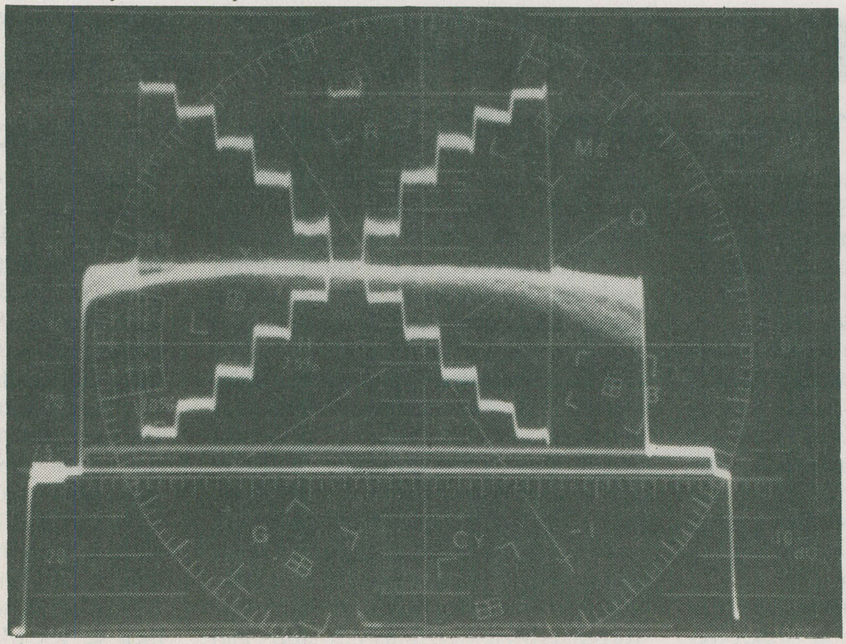


*Fig. 2. The VM-6100A produced the ideal reading for a proper grey scale when viewed on a vectorscope.*

Having had this camcorder in my possession for some time, I've had a chance to discover its quirks as well as appreciate the excellent performance that it is capable of providing. Here is a list of things I wish the unit had or did better. I wish the unit used VHS's hi-fi deep layer recording technique so that its excellent video capabilities could be matched by excellent audio as well. The unit is not equipped with a separate jack on the side of its case for a remote microphone, the slow speed setting of the zoom is too fast and there are clicks in the audio every time you take a shot. There is no flying erase head so in-camera, noiseless edits following a shooting sequence are impossible.

On the plus side, I am impressed with the camcorder's sound pick up. The microphone does not pick up any mechanical noise such as the zoom motor and the wind noise filter is very effective while still providing sufficient sensitivity to record someone's voice from several feet away. I do not miss the lack of a flying erase head. Picture noise never appears between shots provided one keeps the unit on "Cam" rather than on "Vcr." One can even turn the camcorder off while in "Cam" and have it come back on, shoot the next sequence and still not have it exhibit noise between the transition. The automatic controls, particular focusing, work very well, provided that you give them a second or so to adjust before taking a shot. I like the fact that one can plug this camcorder into an S-VHS VCR and make an almost perfect copy. With S-VHS tape being so expensive, I can see that many people will use S-VHS tape as their master tape, making dubs from it to regular VHS for their friends.

A camcorder offering high quality video with the prospect of very little deterioration when copying to other S-VHS tapes is what the Hitachi VM-6100A is all about. If you could live with its price and the few difficulties it presents, you'll be happy with it. ■

FEATURE

# What's New in Video

**The first part of a look at video imaging equipment of all kinds, from today's state-of-the-art to the techniques promised for tomorrow.**

BILL MARKWICK

## THE FUTURE OF VIDEO

### HDTV, Super-VHS, IDTV — where is it all headed?

We've been stuck with the American NTSC television standard since color was introduced in the 1950s, and anyone who's been to Britain or Europe surely must have been struck by the superiority of their video. Further, it's been pointed out that the superb images available from wide-bandwidth computer monitors and EGA/VGA cards have soured people on the quality of TV. And of course, the transfer of movies to video usually leaves you with the feeling that you're only seeing 2/3 of what's there (which is about right). Letterboxing? It should be called "keyholing".

In the past few years, there have been attempts to get the very best out of the existing NTSC standard (said to mean "Never The Same Color"). Super-VHS delivers 400-line resolution, as does the professional-level Beta, but neither system has made much of an impact at the retail level, perhaps because so few movies are available. Maybe the industry will begin to support the better formats, but it's the old chicken-and-egg problem – the public resists expensive new systems because there's no software, and manufacturers are reluctant to support it because sales are low.

When it comes to TV sets themselves, well, they need work. If you have a computer with a composite video output, try playing some computer graphics through a TV, even a good one with "monitor" video inputs. Aggh. Their limited bandwidth can barely produce a recognizable picture, much less a good one. The Improved Definition TV is one step in the right direction – digital framestore and processing can wring every last bit of quality out of the existing NTSC signal, and can use processing tricks to simulate higher resolution. Unfortunately, it's obviously a stop- gap measure, lacking wide-screen as it does, and customers are resisting the very high prices for the extra circuitry. Would you buy a $2500 IDTV if there's a possibility that it could soon be obsolete if HDTV becomes a commercial reality?

High Definition TV, with its wide-screen format, is a reality. Sadly, it's only a reality at trade shows and demonstrations, though people who have seen the various systems agree that the quality is breathtaking. To implement it properly requires more room in the RF spectrum, and the Federal Communications Commission isn't being cooperative. Does this mean a swing back to IDTV? Perhaps – but there's no standard there, either.

To put it mildly, the situation is messy. Perhaps a new technique, such as a variation on the Sarnoff compatible system, will come forth to conquer the spectrum bandwidth problem. Perhaps the FCC really will allocate more room. Maybe the whole system will suddenly get an overhaul. Maybe the backroom wizards have something up their sleeves. Maybe cable TV will be the answer for those who want extra quality.

And maybe not. The usual number that industry critics give when asked about the implementation of HDTV is ten years, which is more likely translated as "we have no real idea". Unless we can convince everyone to chuck out their TVs and start afresh with a better system, we'll just have to wait and see what evolves.

# VIDEO STILL CAMERAS

## Cameras with a 50-shot disk and video output bring a new wrinkle to photography.

Sony first demonstrated the handheld video still camera some years ago, but never did much with it. Now Canon and Panasonic are offering their models, Canon to the high-end consumer and some specialized uses, Panasonic to the industrial user.

### The Canon Xapshot

Canon's RC-250 Xapshot High-Band Still Video Camera is smaller than any 35mm SLR and captures 50 images on a 2" microfloppy disk. It has an f2.8 lens with a focal length of 11mm, equivalent to a 60mm lens on a 35mm camera; the short focal length means that the lens can be fixed-focus with everything sharp from 1m to infinity; a macro setting allows closeups to 30cm. The electronic shutter has a range of 1/30 sec. to 1/500 sec. Color correction (white balance) is automatic.

Once you've captured the pictures you want, the camera will play them back through a color monitor, using an NTSC video output with a resolution of 300 lines/inch. The user can step through single frames, or fast forward/reverse at four frames per second. The internal rechargeable battery allows 800 images without flash, 300 with 25% flash, or 10 minutes of playback time. An AC adapter is available, as are battery packs, a case, handgrip, etc.

You may think that a camera like this would be marketed to the well-heeled gadget lover (since it retails for about $1500), and of course, that's one direction it's aimed in. However, the video output means that the images can be processed like any video: inserted into videotapes or even loaded into a computer via appropriate adapters; the latter would allow use in desktop publishing or processing by paint programs. It also has the appeal of instant playback and little space is needed for tape storage. For further information, contact your local Canon photo dealer.

### Panasonic's AG-ES10

Also recording 50 frames on a 2" disk, the more complex Panasonic is marketed by the Industrial Products Group. It features autofocus, auto white balance, and 400-line resolution. Continuous shooting can be set for 5, 10 or 15 frames per second for motion analysis, and an optional remote control allows "hands-off" shooting, making it ideal for security applications. A top-mounted LCD displays shots remaining, battery condition, time, date and a user-programmed ID number. The time,date and ID are encoded into each image and can be displayed during playback.

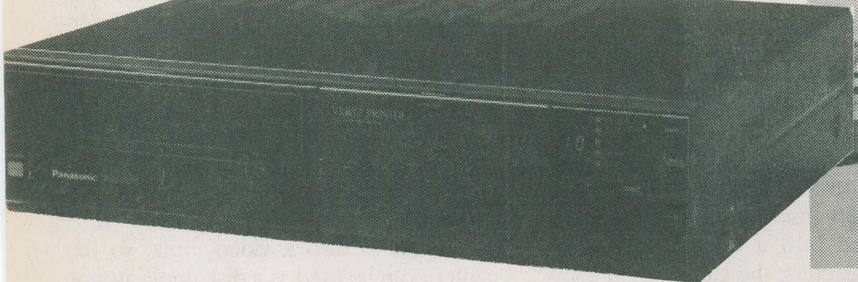
The dual focal length lens offers the equivalent (in 35mm cameras) of 36mm or 64mm. A built-in strobe adjusts to the lens position.

There is also a video input, so the camera can be used as a disk duplicator or editor when used with the Model AG-ES100 Video Floppy Player. The player has a rotary Search Dial for rapid location of images, plus automatic cycling (ideal for trade show displays, etc.).

At twice the price of the Canon, the Panasonic is obviously aimed at the industrial users, and has features to match. Contact the Industrial Products Group, Matsushita Electric of Canada Ltd., 5770 Ambler Drive, Mississauga, Ontario L4W 2T3, (416) 624-5010.


*The Canon Xapshot (left), a fixed-focus camera with a wide range of accessories. The Panasonic AG-ES10 (right), an autofocus camera loaded with features and its playback unit which can rapidly scan through 50 frames.*

# NEW VIDEO ACCESSORIES



## Video Printer

Panasonic's AG-EP70 Electronic Still Video Printer accepts composite, RGB or Y/C inputs and prints within 90 seconds, making it ideal for the video still cameras described elsewhere. The three primary colors have a range of 128 tones each and over 2 million colors. Resolution of the 100 by 148mm print is 448 by 512 dots. Matsushita Electric, 5770 Ambler Drive, Mississauga, Ontario L4W 2T3, (416) 624-5010.

## Polaroid FreezeFrame

The FreezeFrame can produce high quality instant color prints and 35mm slides from any video source: VCRs, cameras, laser disks, or computer graphics. It accepts NTSC video (giving 350 line resolution) or RGB inputs (up to 700 line resolution). Prints are on Type 339 3" by 4" . Controls include brightness, tint, intensity, etc. Polaroid Canada Inc., Electronic Imaging, 350 Carlingview Drive, Rexdale, Ontario M9W 5G6, 1-800-268-6970, Ext. 275.


## Professional Editing Equipment

JVC offers a wide range of editing equipment in the Super-VHS format. A resolution of over 400 lines is possible using separate luminance/ chrominance signals (Y/C). The signals are kept apart during recording and playback to prevent unwanted interaction. JVC Professional Products Group, JVC Canada Inc., 21 Finchdene Square, Scarborough, Ontario M1X 1A7, (416) 293-1311, Fax 293-8208.

## Video Projector

The JVC Super LCD projector features three LCD panels, each with over 210,000 pixels,1 providing a horizontal resolution of 350 lines. Inputs include S-VHS, RGB and composite. The screen size can be up to 120" and even a white wall can be used. An anamorphic conversion lens offers a wide-screen aspect ratio of 16:9. For sources, see the editing equipment at left. ■

## Now from NRI comes the first course of its kind . . . anywhere!

# Learn to use, program, and service today's digital electronic music equipment as you build your own computer-controlled music center

**Now NRI puts you at the heart of the most exciting application of digital technology to date! With NRI's new at-home training in Electronic Music Technology, you get hands-on experience with the equipment that's revolutionizing the music industry—Atari ST Series computer with built-in MIDI ports, Casio CZ101 digital synthesizer with advanced MIDI capabilities, and ingenious MIDI software that links computer keyboard to synthesizer keyboard—all yours to train with and keep.**

This year, over $1.5 *billion* worth of digital electronic music instruments—keyboards, guitars, drum machines, and related equipment—will be sold in the U.S. alone. Who's buying this new-tech equipment? Not just progressive musicians and professional recording technicians, but also thousands of people who have never touched a musical instrument before. And there's good reason why.

Something called MIDI (Musical Instrument Digital Interface) has suddenly transformed musical instruments into the ultimate computer peripherals . . . and opened up a whole new world of opportunity for the person who knows how to use, program, and service this extraordinary new digital equipment.

Now NRI's breakthrough Electronic Music Technology course puts you at the forefront of this booming new technology with exclusive hands-on training built around a MIDI-equipped computer, MIDI synthesizer, and MIDI software you keep.

### Dynamic New Technology Opens Up New Career Opportunities for You

The opportunities are unlimited for the person who's trained to take advantage of today's electronic music phenomenon. Now you can prepare for a high-paying career as a studio technician, sound engineer, recording engineer, or road technician . . . even start your own new-age business providing one-stop sales and service for musicians, technicians, and general consumers alike. Or simply unleash your own musical creativity with the breakthrough training and equipment only NRI gives you.

### Only NRI Gives You an Atari ST Computer, Casio Synthesizer, and Innovative MIDI Software You Train With and Keep

The Atari ST Series computer included in your course becomes the heart of your own computer-controlled music center. With its tremendous power, superior graphics capabilities, and built-in MIDI interface, the 16/32-bit Atari ST has almost overnight become the computer of choice for today's most knowledgeable electronic musicians.

The Casio CZ101 digital synthesizer, also included in your training, is the perfect complement to your Atari ST. The polyphonic, multitimbral CZ101—which stores up to 32 voices internally—"communicates" with your ST computer through MIDI, bringing life to virtually any sound you can imagine.

Plus, you get ingeniously designed MIDI software that opens up amazing new creative and technical possibilities . . . you actually build your own 4-input audio mixer/amplifier . . . and you test the electronic circuits at the core of today's new-tech equipment with the hand-held digital multimeter included in your course.

### No previous experience necessary—in electronics or music!

No matter what your background, NRI gives you the skills you need to take advantage of today's opportunities in electronic music technology.

With your experienced NRI instructor always available to help, you master the basics of electronic theory step by step, gaining the full understanding of electronics that's now so essential for technicians and musicians alike. You move on to analyze sound generation techniques, digital logic, microprocessor fundamentals, and sampling and recording techniques . . . ultimately getting first-hand experience with today's explosive new technology as you explore MIDI, waveshaping, patching, sequencing, mixing, special effects, and much more.

Plus, even if you've never been involved with music before, NRI gives you enough basic training in music theory and musical notation to appreciate the creative potential and far-reaching applications of today's electronic music equipment.

### Send Today for Your FREE Catalog

For all the details about NRI's innovative new training, send the coupon today. You'll receive a complete catalog describing NRI's Electronic Music Technology course plus NRI courses in other high-tech, in-demand electronics fields.

If the coupon is missing, write to NRI School of Electronics, McGraw-Hill Continuing Education Center, 330 Progress Avenue, Scarborough, ON M1P 2Z5

**NRI School of Electronics**
McGraw-Hill Continuing Education Center
330 Progress Avenue, Scarborough, Ontario M1P 2Z5
Main Office: 4401 Connecticut Avenue, NW, Washington, DC 20008

**☑ CHECK ONE FREE CATALOG ONLY**

☐ Electronic Music Technology ☐ Computers and Microprocessors
☐ TV/Video/Audio Servicing ☐ Basic Electronics

Name (Please Print) Age

Street ( ) Telephone

City/Prov./Code

We'll give you tomorrow. Member of Private Career Education Council 5416-089

# Signal Injector/ Tracer

**An easy to build, inexpensive invaluable item of test gear.**

ROBERT PENFOLD

Most electronic testing takes the form of initial checks to narrow down the area of the fault to one particular stage, followed by more detailed checks to determine exactly which component is faulty. A signal injector is a very useful device that is primarily used for the narrowing-down process, but which can sometimes be used for more precise checks. Basically all it does is to generate an audio frequency signal that can be coupled into various stages of audio frequency equipment.

Most signal injectors, including the present design, produce strong harmonics (multiples) of the fundamental audio frequency. These extend well into the radio frequency spectrum, and enable the unit to be used for checks on some kinds of radio receiver (including long and medium wave broadcast sets).

## Fault-Finding Basics

A signal injector is used to test a piece of equipment that has a series of amplifiers or other signal processing stages (tone controls, etc.). The general idea is to inject the signal at the output first, and then gradually work forwards towards the input, injecting the signal at strategic points.

Each test should produce an output from the loudspeaker, headphones, or whatever is being used to monitor the output signal. However, if there is a fault in the unit, at some point the signal will be injected and no signal (or perhaps an inadequate signal) will be forthcoming from the loudspeaker. The fault then lies somewhere in the region of this last test and the previous one.

In fact you can work the other way around, starting at the input and working towards the output of the unit under test. It is then a matter of injecting the signal at various points until a proper signal is obtained from the loudspeaker. Again, the fault will lie somewhere in the region of the last and second-last test points.

There is a body of opinion in favour of making the initial test point somewhere in the middle of the signal chain, with subsequent checks being ahead of or after this point, depending on the result of this initial check. Whichever of these three methods you adopt, or if you adopt a random approach to selecting the test points, the basic idea is still to find successful and unsuccessful test points close together in the signal chain.

## Example

A circuit of the type that can be checked

using a signal injector is shown in Fig. 1. This is a common emitter amplifier based on TR1 and a two stage highpass filter having IC1 as the buffer amplifier. Feeding even a weak signal to the input should produce a strong output due to the high gain of the amplifier. Assuming that this test fails to give a suitable output and that the circuit is faulty, the next injection point would be at the base of TR1, and has presumably gone open circuit (or perhaps it is connected via a "dry" joint).

If this check is successful, the next test point is at the collector of TR1. When using a signal injector you need to bear in mind that connecting the output of the injector to the output of a stage in the test circuit is not necessarily a good idea. t could conceivably result in damage to the injector or the circuit being tested. This is unlikely, but it is quite probable that the output will heavily load the output of the injector so that only a low output level is obtained.

In this case the output impedance of TR1 is relatively high, and the injector should have no difficulty in inserting a fairly high signal level here. It should also have no difficulty in injecting a signal into the subsequent test points at the junctions of C3/C4, C4/C5, and C5/R8.

The output of IC1 is a different proposition, and operational amplifiers (and most other integrated circuit amplifiers for that matter) have a very low output impedance. It would not be advisable to inject a signal into the output of IC1. A much better approach would be to disconnect the positive terminal of C6 from the circuit board, and to inject the signal into this lead.

If a circuit has a lot of stages with low output impedances it might be better to adopt an alternative method of fault finding, such as using a signal tracer (as described elsewhere in this issue).

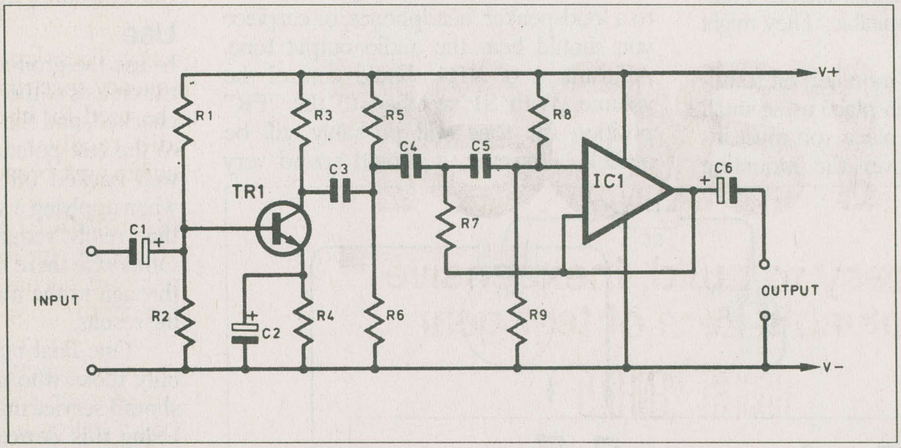



*Fig. 1. A typical circuit of the sort that would be used with the Signal Injector.*

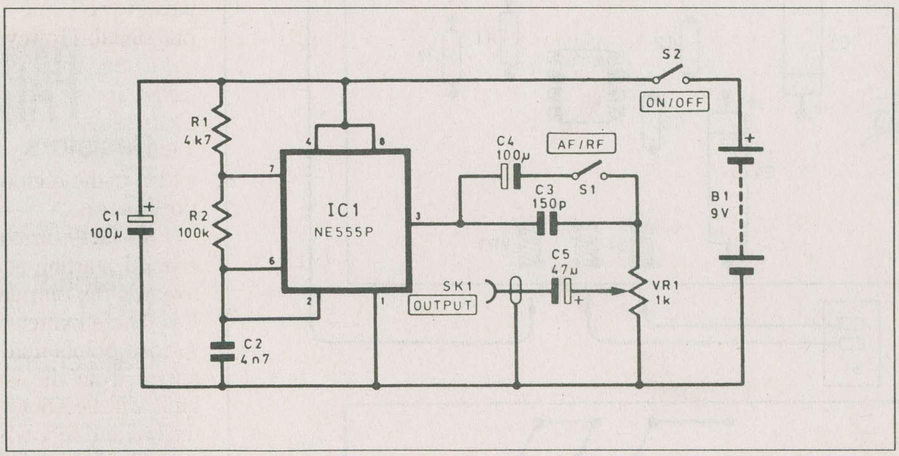



*Fig. 2. The circuit schematic for the Signal Injector.*

## Conclusions

With any electronic testing you should try not to jump to conclusions. There is a very big difference between jumping to conclusions and reaching reasoned conclusions. For example, if applying a signal to the right hand end of C5 produces an output signal, but injecting the signal at the left hand end does not, a fault in C5 is the obvious conclusion. There is another possibility though, which is that R7 has gone short circuit, and is therefore short circuiting this test point to the output of IC7.

Signal injecting will often only indicate the general area of the fault, and some further testing may be needed in order to locate it precisely. In this example one end of R7 could be disconnected. If this restores the output signal, then it is R7 that is faulty. If not, then the defective component is indeed C5. Alternatively, a multimeter could be used to check the resistance of R7.

## The Circuit

The circuit diagram of the Signal Injector is shown in Fig. 2. This is little more than a 555 timer integrated circuit used in the standard astable configuration. There is some advantage in using the TLC555CP low power version of the 555 as this gives somewhat lower current consumption and stronger radio frequency harmonics on the output. The circuit will work quite well with the standard 555, though. Timing components R1, R2, and C2 give a roughly squarewave output at a middle audio frequency of approximately 1kHz.

With S1 in the "RF" position the output signal is coupled via C3 to the output level potentiometer (VR1). The small value of C3 results in the audio frequency content on the output signal being severely attenuated. In theory the audio frequency content of the output signal should be irrelevant when the signal is injected into the RF or IF stages of a radio receiver. In practice a strong audio frequency signal can break through to the output and give misleading results.

When S1 is closed, C4 is switched in parallel with C3, and it then provides full coupling of the output signal through to VR1. C5 provides DC blocking at the output so that connecting the unit to a test circuit will not upset the biasing of that circuit. The unit can provide quite a strong output signal, and it is suitable for testing loudspeakers and headphones.

## Construction

Details of the circuit board and wiring are provided in Fig. 3. Construction of the board is fairly straightforward, using perfboard or Veroboard, but be careful to get the orientations of C1, C4 and IC1 correct. There is a crossover connection on the underside of the board between IC's two rows of pins. Put in one of these wires and then cover it over with insulating tape

at the appropriate place so that it is insulated from the wire that is taken over the top of it.

In places there are several wires running close together. It is important to keep these wires quite taut so that there is no risk of them accidentally short circuiting to one another.

The components should fit into virtually any small plastic case. The controls and SK1 are mounted on the front panel, with the circuit board mounted on the base panel. I used a 3.5 millimetre jack socket for SK1, but virtually any two-way socket can be used here. Two single-way sockets such as 2 millimetre types are also suitable. They might be less fiddly to wire up.

The board can be mounted on stand-offs, or it can be fixed in place using small bolts. If it is bolted in place you must include short spacers over the mounting bolts. Without these, the components will be forced from the circuit board as the mounting nuts are tightened.

The point to point wiring is not too difficult. The connections to the board are made via flying leads soldered to the underside. The other ends of the leads are bound to the component tags using the **Easiwire** "pen". Note that C5 is mounted off-board, and is wired direct to SK1 and VR1. Take care to connect it the right way around, as it's a polarized type.

## Testing

With the unit switched on and connected to a loudspeaker, headphones, or earpiece you should hear the audio output tone. Adjustment of VR1 should control the volume. With S1 switched to the "FR" position the tone will probably still be audible. However, it should sound very thin, with most of the fundamental and lower harmonics being filtered out. It may be barely audible if the output is fed to a low impedance loudspeaker.

A more useful check is to connect a set of test leads to the output of the unit, and to place the non-grounded lead very close to a radio receiver tuned to the long or medium wavebands. The radio should pick up the harmonics and produce the audio tone regardless of the setting of the tuning control (except that strong transmissions might operate the receiver's automatic gain control circuit and leave the tone barely audible).

## Use

In use the grounded test lead connects to the chassis of the piece of equipment being checked, and the other test lead is applied to the test points. It is best to keep VR1 well backed off and to only advance it when applying a signal to a part of a circuit that really requires a high signal level. Otherwise there is a risk of signal breaking through to the output and giving misleading results.

One final but important point is that **only those who are suitably experienced should service mains powered equipment. Using this device to test mains powered equipment that does not incorporate an isolation transformer could prove lethal.**

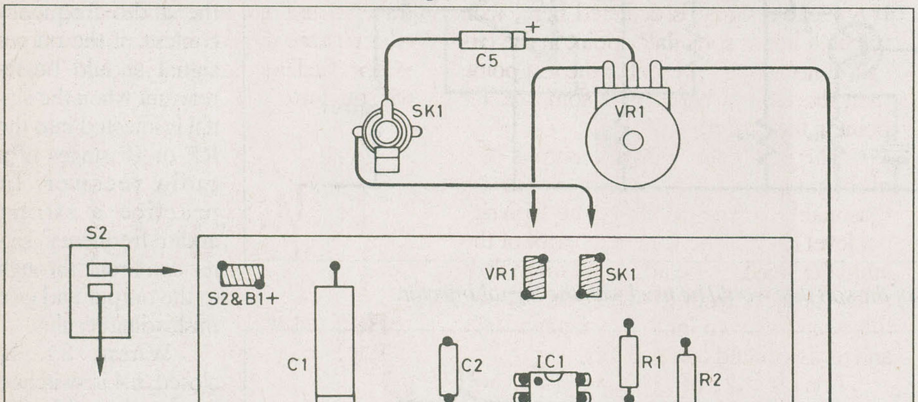



*Fig. 3. Construction of the Signal Injector.*

# PARTS LIST

### Resistors

R1 .............................. 4k7
R2 .............................. 100k
0.25 watt 5% carbon

### Potentiometer

VR1 .............................. 1k lin.

### Capacitors

C1,C4 .............. 100u elect. 10-16V
C2 .............................. 4n7
C3 .............................. 150p ceramic
C5 .............................. 47u elect. 10-16V

### Semiconductor

IC1 NE555P or TL555P timer (see text)

S1,S2 ........... SPST sub-min toggle
B1 .............................. 9 volt battery
SK1 . 3.5mm jack socket (see text)

Battery connector; 8 pin DIP socket; case; perf or Veroboard; control knob; wire; etc.

# SIGNAL TRACER

## Tracing Technique

A signal tracer is used in much the same way as a signal injector (as described in the previous section), but I suppose could be regarded as the inverse of an injector. Rather than generating a signal, it takes a signal from the test circuit, amplifies it, and feeds it to a loudspeaker. In other words, it is just a reasonably sensitive audio power amplifier and loudspeaker. It could be regarded as the electronic equivalent of a stethoscope.

Apart from use as a signal tracer, this unit is one of those general purpose items of equipment that no electronics hobbyist should be without. A device of this type proves to be indispensable on numerous occasions when testing projects or just dabbling with circuits. It can save hours of time being held up by what turns out to be a simple problem with a broken socket, short circuited plug, etc., as well as sorting out more difficult problems.

As when using a signal injector, the basic idea of signal tracing is to find a break in the signal chain. It is used for testing the same types of equipment, which means linear circuits having a series of amplifiers of other signal processing stages.

If a signal tracer was used to check the test circuit in the *signal Injector* article (Fig. 1 of that article), the first requirement would be that a suitable signal should be applied to the input of the circuit. This signal could be provided by a signal injector or generator, but where possible I prefer to use the normal signal source for equipment. One advantage is that this automatically provides the equipment with an input of the correct amplitude. Also, you will not always be searching for a complete break in the signal path. The problem might be one of distortion, and any distortion will probably be more noticeable on a speech or music signal than on a simple test signal.

In common with signal injection, you can start at the input, the output, or in the middle. For this example we will assume that the starting in the middle technique is to be adopted. An acceptable first test point would therefore be at the junction of C3 and C4 (Fig. 1, *Signal Injector* article). If a suitable signal is detected here, then the fault lies at some later point in the circuit. If no signal is present at the test point, then the fault is here, or at some earlier point in the circuit.

This test point is at the output of a high gain amplifier, and it would be reasonable to expect a reasonably high signal level here. If the volume control of the amplifier needs to be advanced more than a few degrees from its minimum setting, this would tend to indicate a fault in TR1 and its associated components.

For the sake of this example we will assume that the signal is either not detected, or is at a grossly inadequate level. We must therefore try earlier points in the signal path in an attempt to find one that does provide a signal. If (say) the signal is present at both sides of C1, but appears at the collector of TR1 and in subsequent stages at only about the same level, this would suggest that TR1 is failing to amplify the signal properly and is faulty.

The problem could be due to a fault in one of the other components in this part of the circuit though. C2 going open circuit or not being connected properly would result in low gain through TR1. It is easy to test for this using the signal tracer, and it is just a matter of checking for a signal at the emitter of TR1. The decoupling effect of C2 should result in no significant signal here.

If the signal level at TR1's emitter is much the same as the signal level at its base, this would suggest that C2 is not having any effect on the circuit. A signal tracer is just as useful for detecting signals where there should be none present, as it is for finding signals that are "absent without leave".

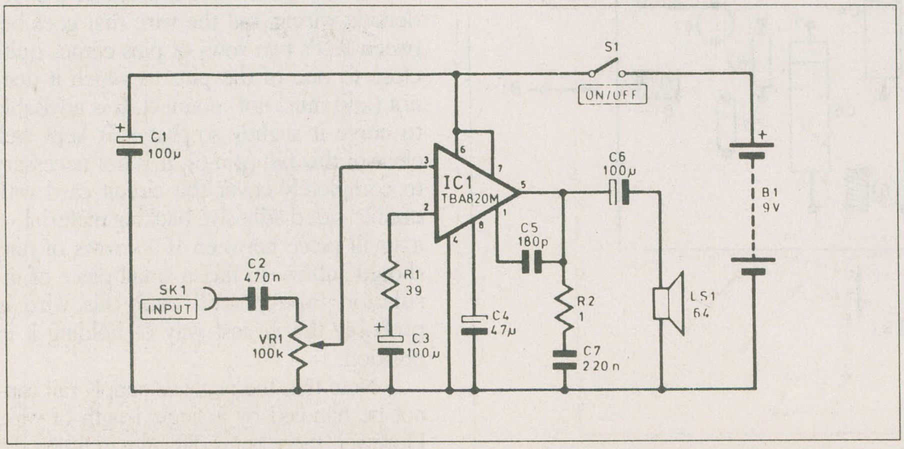



*Fig. 1. Circuit diagram of the Signal Tracer.*

## PARTS LIST

### Resistors

R1 .................... 39
R2 .................... 1
0.25 watt 5% carbon

### Potentiometer

VR1 .................... 100k log. carbon

### Capacitors

C1,C3 .................... 100u elect. 10-16V
C2 .................... 470n
C4 .................... 47u elect. 10-16V
C5 .................... 180p ceramic
C6 .................... 100u elect. 10-16V
C7 .................... 220n

### Semiconductor

IC1 TBA820M (or LM386 – see box)

### Miscellaneous

SK1 Standard jack socket (see text)
LS1 64 ohm loudspeaker (see text)
B1 9 volt battery
S1 SPST sub-min toggle

Battery connector; 8 pin DIP socket; case; board; control knob; wire; etc..

## Circuit

There are a number of small audio power amplifier integrated circuits which could be used as the basis for a unit of this type. I chose the TBA820M as it is readily available, has quite a good specification, and is well suited to battery operation. It will work on supply voltages as low as three volts, and it has a low quiescent current consumption of only about four milliamps. The full circuit diagram for the Signal Tracer appears in Fig. 1.

The input signal is coupled via DC blocking capacitor C2 to volume control VR1. From here the signal is coupled straight into the non-inverting input of IC1. No DC blocking capacitor is needed here. In fact VR1 acts as the input bias resistor for IC1, and so it is essential that no input coupling capacitor should be used.

Capacitor C5 provides a small amount of high frequency attenuation which aids the stability of the circuit. This does not significantly affect the unit's audio frequency response. C4 is a decoupling capacitor that helps avoid problems with instability due to feedback through the supply rails (as does the main supply decoupling capacitor, C1).

## Gain

The voltage gain of the circuit is controlled by an internal feedback resistor, and discrete feedback components R1 and C3. The specified value for R1 gives a voltage gain approaching 200 times, and an input of only about 10mV RMS will drive the amplifier to full output power.

In this application there is an advantage in high sensitivity and high impedance as this enables very weak signals to be detected. The gain and input impedance could be made higher by raising the value of VR1 and reducing the value of R1. The specified values probably represent the best compromise for these components, since boosting the gain and input impedance would risk instability due to stray feedback, and would reduce the output quality. The sensitivity is quite good anyway. Remember that 10 mV is needed for full output power, but inputs of well under a millivolt will produce a clearly audible output.

Capacitor C6 couples the output signal to a high impedance loudspeaker (LS1). The maximum output power into a high impedance speaker is not very high, and is less than 100 milliwatts RMS This should be sufficient for the present application, but an eight ohm impedance loudspeaker can be used if a higher output power is required (at the expense of current consumption and therefore battery life). R2 and C7 are needed in order to prevent high frequency instability.

Although the quiescent current consumption of the circuit is typically only 4mA, the current drain rises significantly at high volume levels. Using a high impedance loudspeaker the average current consumption is still only likely to be about 10 milliamps or so, and a PP3 size battery should be adequate. I would recommend a higher capacity type (such as six HP7 size cells in a holder) if an eight ohm impedance loudspeaker is used.

## Construction

The circuit and wiring are shown in Fig 2. Assembly of the board presents few problems, but be careful to get IC1 and the electrolytic capacitors fitted to the board the right way round.

There are no cross-overs in the underside wiring, but the wire that goes between IC1's two rows of pins comes quite close to one of the pins to which it does not (and must not) connect. It is advisable to curve it slightly so that it is kept well clear of this pin (pin 6). It is not necessary to completely cover the circuit card with double-sided adhesive backing material — a small piece between IC1's rows of pins should suffice. In fact a small piece of insulation tape placed over this wire is probably the easiest way of holding it in position.

Note that the negative supply rail cannot be handled by a single length of wire. However, there is no difficulty in fitting the main wire and then adding the branch wire which carries the ground connection to LS1.

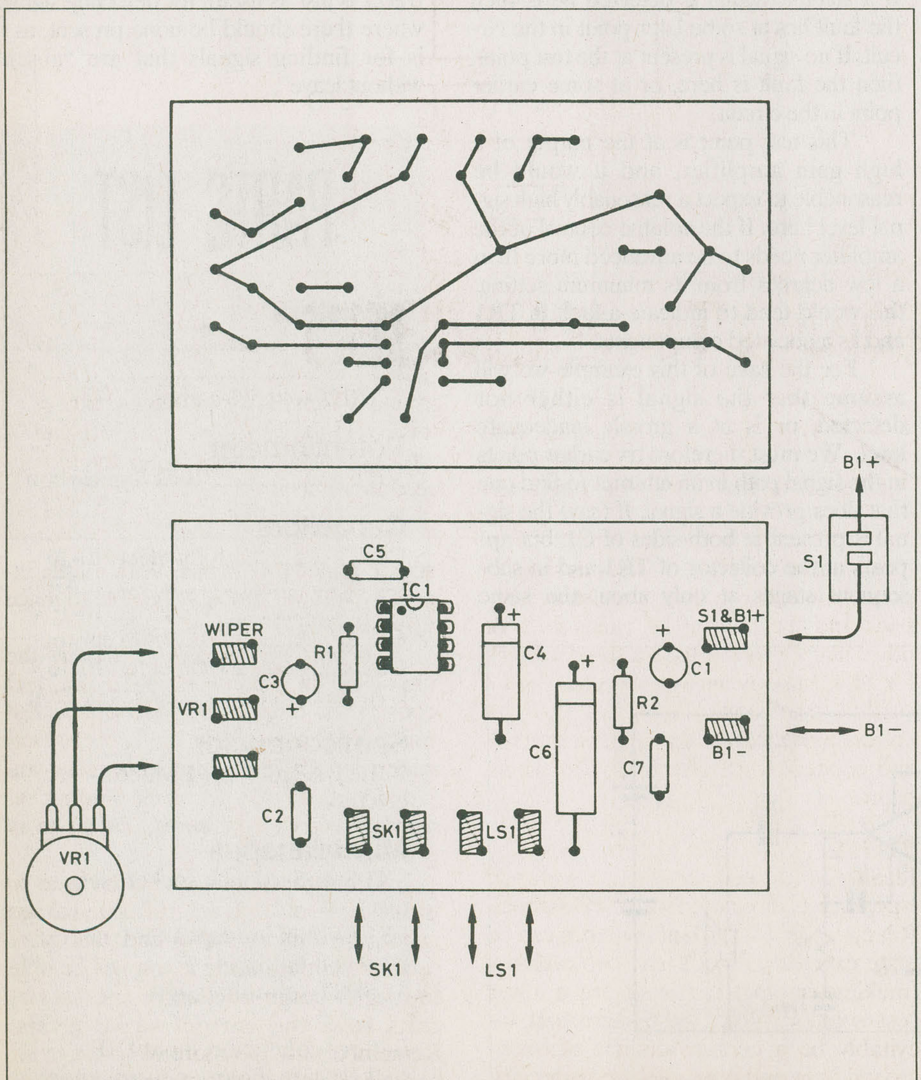
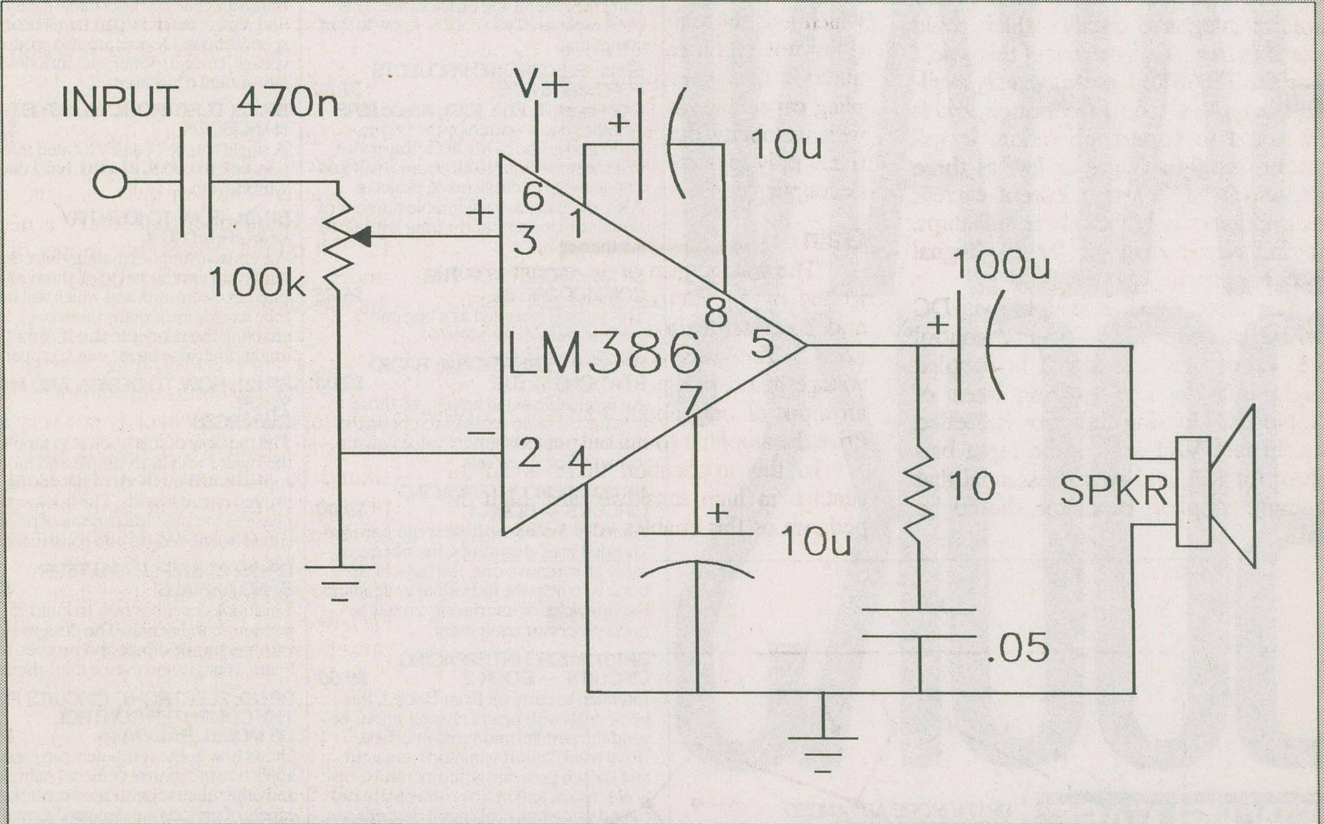



*Fig. 2. Construction of the signal tracer.*




# SUBBING THE LM386

If the TBA820 is unavailable, the LM386 power amp (Radio Shack 276-1731) will provide the same specifications with a few different parts and a slightly different pinout. The schematic is shown above.

The differing parts are the 10u from pins 1 to 8, which sets the gain at the required 200, the 10u from pin 7 to ground, which improves the rejection of noise from the V+, and the .05/10 ohm network on the output, used for high frequency stability.

The unit should fit into most small plastic cases, but be careful to choose one that will provide sufficient space for the loudspeaker. A grille for the loudspeaker must be made in the case. The easiest way of doing this is to drill a matrix of small holes (about five millimeters in diameter will do). Take care to position the holes accurately, as it is easy to make a slightly sloppy job of this.

Miniature loudspeakers rarely have provision for screw mounting. Consequently, it will almost certainly have to be glued in place using a good quality general purpose adhesive. Avoid smearing any adhesive onto the diaphragm as this could seriously impair the audio output.

Try to arrange the layout so that the wiring to VR1 and SK1 is not intermingled with that of the loudspeaker. This would encourage stray feedback and instability. The input wiring should b kept as short as possible in order to discourage stray feedback and the pick up of mains hum or other interference. I used a standard jack for SK1, but any audio connector should suffice. You could even just drill an entrance hole for the test leads in the case and connect them directly to the circuit board.

## In Use

Ideally the test lead should be a screened type, such as those used with oscilloscopes. Ready-made test leads of this types can be quite expensive though, and two ordinary (multimeter type) test leads are a lower cost solution. With these there will inevitably be a certain amount of background hum and other pick up, especially when the leads are not connected to a signal source, or are connected to a weak high source impedance signal. With a little ingenuity you will probably be able to make up your own shielded test leads.

Connect the ground test lead to the chassis of the equipment under test, and connect the other lead to the various test points. Unless you have the necessary experience and are sure you know what you are doing, **do not try fault finding on mains powered equipment. To do so is potentially fatal.**

Although the unit cannot be used to measure signal levels and calculate voltage gains, you will probably find that after some experience using it you will be able to roughly gauge whether or not test circuits have the correct signal levels. Remember that the more VR1 has to be backed off in order to prevent overloading, the stronger the signal at the test point. ■

# BABANI BOOKS

## NEW RELEASE

**BP 256: AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN** *$11.80*
This book explores many types of enclosures and drive units. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them.

**246: MUSICAL APPLICATIONS OF THE ATARI STs** *$15.00*
A wide selection of topics is covered, including the internal sound chip, MIDI, applications programs such as sequencing and score writing, etc. Simple but useful add-on projects and MIDI programming.

**BP240: REMOTE CONTROL HANDBOOK** *$12.00*
Includes remote control systems, transmission links, digital electronics, methods of control, coders, decoders, etc.

**BP111: AUDIO** *$14.00*
This one is ideal for readers who want to really get into sound. A wide range of material is covered from analysis of the sound wave, mechanism of hearing, acoustics, microphones and loudspeakers, amplifiers, and magnetic disc recording.

**BP239: GETTING THE MOST FROM YOUR MULTIMETER** *$9.00*
This book is aimed at beginners and those of limited experience of electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

**BP53: PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE** *$11.75*
A book that bridges the gap between complicated technical theory and the "cut and try" method. A good reference book.

**BP174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS** *$12.00*
Complementing Book PB74, "Electronic Music Projects", BP174 provides more advanced projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an Introduction circuit diagram and constructional notes.

**BP113: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 2** *$9.00*
**R.A. Penfold**
A companion to BP107. Describes a variety of projects that can be built on plug-in breadboards using CMOS logic IC's. Each project contains a schematics, parts list and operational notes.

**BP150: AN INTRO TO PROGRAMMING THE SINCLAIR QL** *$7.80*
Helps the reader make the best use of the Sinclair QL's almost unlimited range of features. Complements the manufacturer's handbook.

**BP192: MORE ADVANCED POWER SUPPLY PROJECTS** *$8.00*
**Robert Penfold.**
A companion to BP76, this book covers switched mode supplies, precision regulators, tracking regulators, computer- controlled supplies, etc.

**BP222: SOLID STATE SHORT WIVE RECEIVER FOR BEGINNERS** *$7.80*
**R.A. Penfold**
In this book, R.A. Penfold has designed and developed several modern solid state short wave receiver circuits that will give a fairly high level of performance, despite the fact that they use only relatively few and inexpensive components.

**BP197: INTRODUCTION TO THE AMSTRAD PCs** *$20.00*
The Amstrad PC is an MS- DOS computer for general and business use. This book explains all you need to know to start computing.

**BP48: ELECTRONIC PROJECTS FOR BEGINNERS** *$7.80*
**F.G. Rayer, T. Eng. (CEI), Assoc.IERE**
Another book written by the very experienced author - Mr. F.G. Rayer - an in it the newcomer to electronics will find a wide range of easily made projects. Also, there are a considerable number of actual components and wiring layouts, to aid the beginner.

**BP135: SECRETS OF THE COMMODORE 64** *$5.85*
This book is intended as a beginner's guide to the Commodore 64.

**BP155: INTERNATIONAL RADIO STATIONS GUIDE** *$9.00*
An invaluable aid in helping all those who have a radio receiver to obtain the maximum entertainment value and enjoyment from their sets.

**BP130: MICRO INTERFACING CIRCUITS — BOOK 1** *$9.00*
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

**BP131: MICRO INTERFACING CIRCUITS — BOOK 2** *$9.00*
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. "Real world" interfacing such as sound and speech generators, temperature, optical sensors, and motor controls are discussed using practical circuit descriptions.

**BP51: ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING** *$5.85*
This book sets out to show how Electronic Music can be made at home with the simplest and most inexpensive equipment.

**BP74: ELECTRONIC MUSIC PROJECTS** *$10.00*
**R.A. Penfold**
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular and there are many projects which fall into this category. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuxx Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser Units, Tremelo Generator, etc.

**BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING** *$7.80*
**R.A. Penfold**
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

**BP86: AN INTRODUCTION TO BASIC PROGRAMMING TECHNIQUES** *$5.85*
This book is based on the author's own experience in learning BASIC and also in helping others, mostly beginners to programming, to understand the language.

**BP234: TRANSISTOR SELECTOR GUIDE** *$15.00*
Listings of British, European and eastern transistor characteristics make it easy to find replacements by part number or by specifications. Devices are also grouped by voltage, current, power, etc., includes surface-mount conversions.

**BP233: ELECTRONIC HOBBYIST HANDBOOK** *$15.00*
A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

**BP101: HOW TO IDENTIFY UNMARKED IC's** *$1.95*
An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the rEader to use IC's that might otherwise have been scrapped.

**BP121: HOW TO DESIGN AND MAKE YOUR OWN PCBs** *$5.85*
The purpose of this book is to familiarize the reader with both simple and more sophisticated methods of producing printed circuit boards. The book emphasizes the practical aspects of printed circuit board designs and construction.

**BP125: 25 SIMPLE AMATEUR BAND AERIALS** *$5.85*
This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

**BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS** *$9.00*
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control, etc.

**BP78: PRACTICAL COMPUTER EXPERIMENTS** *$5.25*
The aim of this book is to enable the reader to simply and inexpensively construct and examine the operation of a number of basic computer circuit elements and it is hoped gain a fuller understanding of how the mysterious computer "chip" works.

**BP185: ELECTRONIC SYNTHESIZER CONSTRUCTION** *$9.00*
With this book a relative beginner should be able to build, with a minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesizer and also learn a great deal about electronic music synthesis in the process.

**BP115: THE PRE-COMPUTER BOOK** *$5.85*
Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but either intend to one day own one or simply wish to know something about them.

**BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION** *$5.25*
This is a book written especially for those who wish to participate in the intricacies of electronics.

**BP72: A MICROPROCESSOR PRIMER** *$5.25*
In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the short-comings of this simple machine will be discussed and the reader is shown how these can be overcome. Includes a glossary of microprocessor terms.

**BP42: 50 SIMPLE L.E.D. CIRCUITS** *$5.85*
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components.

**BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE** *$9.00*
This book is designed to help the user find possible substitutes for a popular user-oriented selection of modern transistors and includes devices produced by over 100 manufacturers.

**BP140: DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS** *$15.00*
Shows equivalents and pin connections of a popular user- oriented selection of Digital Integrated Circuits. Includes European, American and Japanese devices.

**BP100: AN INTRODUCTION TO VIDEO** *$5.85*
This book is for the person who has just, or is about to buy or rent video equipment but is"nt sure what it's all about.

**BP136: SIMPLE INDOOR AND WINDOW AERIALS** *$7.00*
People living in apartments who would like to improve shortwave listening can benefit from these instructions on optimizing the indoor aerial.

**BP156: AN INTRODUCTION TO QL MACHINE CODE** *$10.00*
The powerful sinclair QL microcomputer has some outstanding capabilities in terms of its internal structure. With a 32-bit architecture, the QL has a large address range, advanced instructions which include multiplication and division.These features give the budding machine code programmer a good start at advanced programming methods. This book assumes no previous knowledge of either the 68008 or machine code programming.

**BP258 LEARNING TO PROGRAM IN C** *$19.00*
This book is a guide to C programming. C statements are introduced and explained with the help of simple, but completely working programs.

**BP141: LINEAR IC EQUIVALENTS AND PIN CONNECTIONS** *$23.80*
**Adrian Michaels**
Find equivalents and cross-references for both popular and unusual integrated circuits. Shows details of functions, manufacturer, country of origin, pinouts, etc... includes National, Motorola, Fairchild, Harris, Intersil, Philips, ADC, AMD, SGS, Teledyne, and many other European, American and Japanese brands.

**BP7: RADIO AND ELECTRONICS COLOUR CODE AND DATA CHART** *$3.00*
Opens out to Wall Chart approximately 584 X 457mm. Includes many Radio & Electronics Colour Codes in use in UK, USA, Europe and Japan. Covers Resistors, Capacitors, Transformers, Field Coils, Fuses, Battery Leads, etc.

**BP225: A PRACTICAL INTRODUCTION TO DIGITAL ICs** *$7.00*
This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are in cluded as well as details for a more complicated Digital Counter Timer project.

**BP147: AN INTRODUCTION TO 6502 MACHINE CODE** *$10.00*
The popular 6502 microprocessor is used in many home computers; this is a guide to beginning assembly language.

**BP59: SECOND BOOK OF CMOS IC PROJECTS** *$7.80*
This book carries on from its predecessor and provides a further selection of useful circuits, mainly of a simple nature. The book is well within the capabilities of the beginner and more advanced constructor.

**BP88: HOW TO USE OP-AMPS** *$11.80*
**E.A. Parr**
A designer's guide covering several op-amps, serving as a source book of circuits and a reference book for design calculations. The approach has been made a non-mathematical as possible.

**ELEMENTS OF ELECTRONICS - AN ON-GOING SERIES**
**F.A. Wilson, C.G.I.A., C.Eng.,**
*$11.80 EACH OR ALL 5 BOOKS FOR $44.00*
Although written especially for readers with no more than ordinary arithmetical skills, the use of mathematics is not avoided, and all the mathematics required is taught as the reader progresses.

Each book is a complete treatise of a particular branch of the subject and therefore, can be used on its own with one proviso, that the later books do not duplicate material from their predecessors, thus a working knowledge of the subjects covered by the earlier books is assumed.

**BP62: BOOK 1.** This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

**BP63: BOOK 2.** This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

**BP64: BOOK 3.** Follows on semiconductor technology, leading up to transistors and integrated circuits.

**BP77: BOOK 4.** A complete description of the internal workings of microprocessor.

**BP89: BOOK 5.** A book covering the whole communication scene.

**BP194: MODERN OPTO DEVICE PROJECTS** *$9.00*
This book provides a number of practical designs for beginners and experienced project builders. These projects utilize a range of modern opto-electric devices, including such things as fibre optics, ultra-bright LEDs and passive IR detectors.

**BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS** *$7.80*
**F.G. Rayer, T. Eng., (CEI), Assoc. IERE.**
Relays, bi-directional triodes (TRIACs), and silicon controlled rectifiers (SCRSs), have a wide range of applications in electronics today. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct. In most of the circuits there is a wide latitude in component values and types, allowing easy modification and ready adaptation of them to individual needs.

**BP84: DIGITAL IC PROJECTS** *$7.80*
**F.G. Rayer, T. Eng. (CEI), Assoc. IERE.**
This book contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome.

**BP95: MODEL RAILWAY PROJECTS** *$7.80*
Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered included controllers, signals and sound effects: stripboard layouts are provided for each project.

**BP144: FURTHER PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE** *$15.00*
This book covers many aspects of electronics where a knowledge and familiarity of the appropriate formulae is essential for a fuller understanding of the subject. An essential addition to the library of all those interested in electronics be they amateur, professional or student.

**BP44: IC 555 PROJECTS** *$10.00*
**E.A. Parr, B.Sx., C. Eng., M.I.E.E.**
Every so often a device appears that is so useful that one wonders how life went on before it. The 555 timer is such a device included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

**BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS** *$7.80*
**R.A. Penfold**
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, and more.

**BP49: POPULAR ELECTRONIC PROJECTS** *$10.00*
**R.A. Penfold**
Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors. The projects selected cover a very wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

**BP99: MINI-MATRIX BOARD PROJECTS** *$7.60*
**R.A. Penfold**
Twenty useful projects which can all be built on a 24 X 10 hole matrix board with copper strips. Includes Door-buzzer, Low-voltage Alarm, AM Radio, signal Generator, Projector Timer, Guitar Headphone Amp. and more.

**BP103: MULTI-CIRCUIT BOARD PROJECTS** *$7.80*
**R.A. Penfold**
This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

**BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2** *$9.00*
**R.A. Penfold**
70 plus circuits based on modern components aimed at those with some experience.

**BP127: HOW TO DESIGN ELECTRONIC PROJECTS** *$9.00*
Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

**BP195: AN INTRODUCTION TO SATELLITE TELEVISION** *$15.00*
For the absolute beginner or anyone thinking about purchasing a satellite TV system, the story is told as simply as such a complex one can be.

**BP106: MODERN OP-AMP PROJECTS** *$7.80*
**R.A. Penfold**
features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra-high input impedance, high slew-rate and high output current types.

**BP107: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 1** *$9.00*
**R.A. Penfold**
A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects featured in this book have been specially designed to be built on a "Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of reasonably inexpensive components it is possible to build, in turn, every project shown.

**BP122: AUDIO AMPLIFIER CONSTRUCTION** *$6.75*
A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities of even those with limited experience.

**BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS** *$12.00*
The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

**BP108: INTERNATIONALDIODE EQUIVALENTS GUIDE** *$7.00*
Cross-references European, American and Japanese diode part numbers. Besides rectifier diodes, it includes Zeners, LEDs, Diacs, Triacs, SCRs, OCIs, photodiodes, and display diodes.

**BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS — BOOK 2** *$7.60*
**R.A. Penfold**
This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals. Amplifiers and filters account for most of the book but comparators, Schmitt triggers and other circuits are covered.

**BABANI BOOKS EXCLUSIVELY AVAILABLE IN CANADA FROM MOORSHEAD PUBLICATIONS. ORDER YOUR SELECTIONS BY TELEPHONE: (416) 445-5600 OR FAX: 416-445-8149 OR WRITE TO US AT 1300 DON MILLS ROAD, NORTH YORK, ONTARIO M3B 3M8**

FEATURE

# PC Hardware Interfacing Part 8

## This month we're going to look at a paper design problem involving the 8250 serial port chip we looked at last month. Rather than simply seeing how it works, we're going to see how it can be *made* to work.

STEVE RIMMER

A whole book full of circuits isn't nearly as good as knowing how to design something. Looking at circuits which other people have gotten together will show you how the hardware in question operates... assuming you can read schematics and know what all the chips do... but it won't really teach you how to take a pile of loose chips, some specification sheets and a prototype board and make a working circuit out of them.

This is especially true when one is looking at hardware design for computers. Much of the confusion in this area stems from the observation that no two chip manufacturers use the same nomenclature for anything and, in fact, it is not at all uncommon for two chips from the *same* manufacturer to be described in different terms. As such, the "cookbook" electronics of computers really isn't... you can't just assemble the appropriate building blocks and go rock 'n roll. Rather, you must really understand the functionality of all the parts.

The upside of this is that, assuming you do get your head around what all the lines and signals are for, you can create paper designs that usually work. Most of the computer hardware I've prototyped has done what it was supposed to do as soon as it was powered up, barring a few solder bridges and bad parts. This is not because I'm unusually good at this stuff but, rather, because computer hardware design is really an exercise in logic. You can't just wire together black boxes and hope it'll all work, but you can wire together functional elements once you understand their functions.

Out of this obtuse bit of electronic zen, let's get down to a design problem of a manageable level of hugeness. We're going to design an interface between the 8250 serial port chip we looked at last month and the PC's peripheral bus. Now, this is a good design project because it's not very hard, happens to proceed logically without any mysterious secrets and... perhaps most important for this sort of illustration... has already been done. Once we have worked through the logic of the process we can peek into the IBM technical reference manual to see if our design will really work.

### Ride That Bus

This month, let's see how the basic interfacing of the chip to the address and data buses takes place. This is a variation of the I/O decoder stuff we've looked at to date. Please note that this month's schematics are not complete... don't attempt to build anything just yet.

The 8250 requires a range of eight ports. By convention, the serial ports on a PC live in the ranges of 3F8H to 3FFH for the primary port and 2F8H to 2FFH for the secondary port. We're going to be designing a primary port here... for one thing because the decoding is so gloriously easy.

We know that we will have to select among the eight ports of the chip, even if we don't know what they actually do. As such, we will leave the three lowest order address lines out of the decoding problem. These can be connected directly to the A0 through A2 address lines of the bus, as, when our decoder says that the port address of the 8250 is being accessed by the processor, these lines will contain the port address of the actual internal register to be dealt with. Ignore this stuff for the moment.

The port range will be addressed by the processor's address lines A3 through A8, for a total of six lines. Because our port sits at the top of the PC's port range, if all these lines are high... and several other signals are as they should be, as you may recall from previous installments in this series... the PC is obviously trying to

If we wanted to make our card a secondary serial port, down at 2F8H, we would do so by changing one line. If this is the decoding for the secondary port range,

**Hex address 2F8**

**Binary address 001011111000**

it's clear that all we have to do to modify our I/O decoding for this range is to put an inverter between data line eight of the PC's bus and the big NAND gate. In a real world design, we could make this feature jumper selectable.

There are a few other lines to consider in this basic level of decoding, but we'll leave them until next month.

## Byte Sized Chunks

In theory, the I/O decoding of the 8250 should work very much like that of the basic PC card we've looked at in this series. In practice, there are a few spaniels in the works. The port range is different, for one thing, although this has turned out to actually make the I/O decoding a bit easier. The more important aspect of this real world application is that it's no longer obvious which lines of the thing we'll be interfacing to connect to the lines of the PC's peripheral bus. Even in the little bit of interfacing we've seen here, it has been necessary to understand a bit of what is going on in the workings of the 8250.

Next month we'll finish off the basic address and data bus interface and touch on some of the really odd bits of the 8250. ■

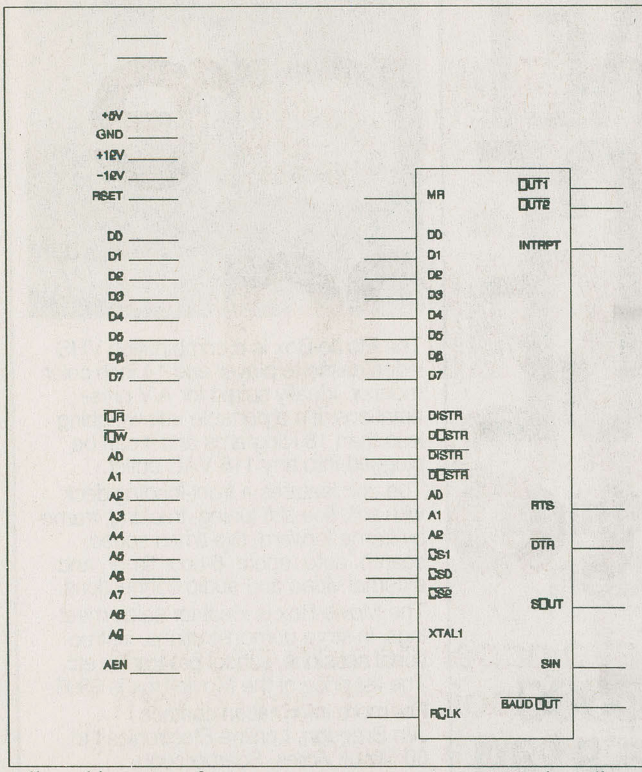


*Figure 1. The chip and the bus, all ready for interfacing*

talk to this range of ports.

We can simply run all of the little devils into a big NAND gate. If the output of the gate goes low, our 8250 is being addressed. This is, to be sure, I/O decoding with no pain at all.

The 8250 provides three chip select lines. We'll tie CS0 and CS1 high, as they're not going to be used. Remember, the NAND gate will go low when our chip is being addressed, so we want a select line that will be active when the voltage on it *drops*. In other words, we want $\overline{CS2}$, the inverse chip select.

When the 8250 is selected, it will communicate with the data bus, reading and writing data as is appropriate. When it is not selected, it appears as if it doesn't exist as far as the processor is concerned.

In fact, convention dictates that the data bus of the PC be separated from that of the 8250 by a 74LS245 bidirectional buffer. As such, we have not tied the 8250's data lines right to those of the PC, but have splashed one of these glue chips in between. We'll see more about this next month.

If the PC wanted to access port 3F8H of the 8250... that's the serial data input register, as it happens... it would put the number 3F8H on its data bus and jiggle the right lines for a port access. We can look at this as follows

**Hex address 3F8**

**Binary address 001111111000**

It's easy to see here why our simple I/O decoding works so well. The three zeros under the eight represent the three lowest order address lines, the ones which actually select our port. The six ones under the three and the F are the six lines which must go high if our port range is to be selected. The two zeros under the three are ignored lines.

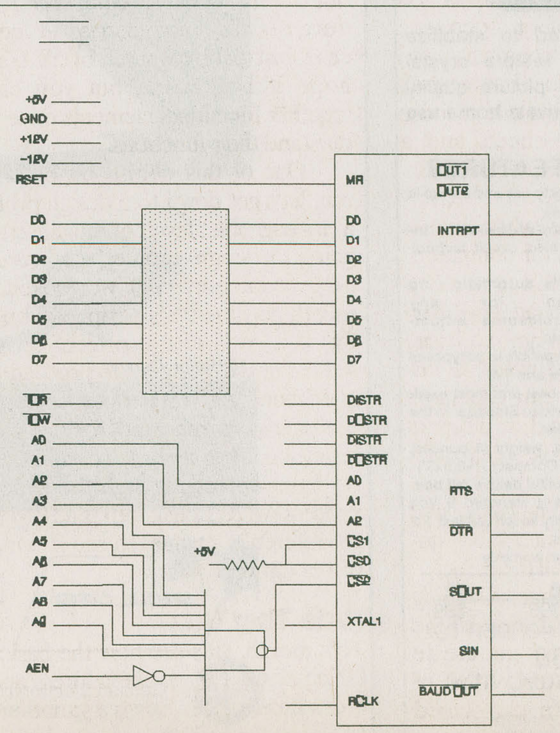
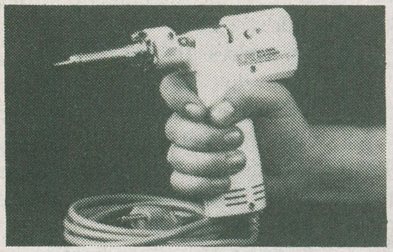


*Figure 2. Adding some basic I/O decoding and a few other lines.*

# NEW IN CANADA

## SOLDER CLEANER/ HOT AIR BLOWER



•Dual function tool •Lightweight •Manageable •Portable •Hand Held

### SOLDER CLEANER

Self contained unit eliminates foot pedal and trailing hoses. Powerful pump capacity (15L/min). 60 watts heater with built in thermal sensor control, adjustable from 250°C to 420°C.

### HOT AIR BLOWER

Ideal for heat shrink and epoxy work.

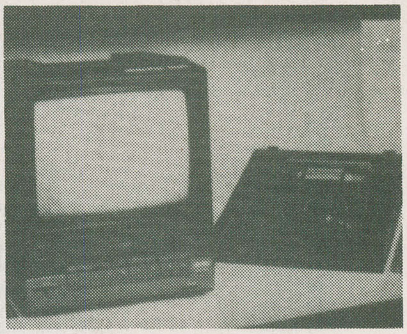
CES ComTech Electronic Suppliers

WHOLESALE – RETAIL ELECTRONIC PARTS
1020 Gardiners Road, Kingston, Ontario K7P 1K2
PHONE (613) 384-9400 FAX (613) 384-9379

# MARKET PLACE

For Advertising Information Call
(416)445-5600
Fax 416-445-8149

# MOVIE- BOX



The Movie-Box is a combination VHS video cassette player and 14 inch color monitor, ideally suited for A/V presentations. It's a portable unit weighing less than 18 kilograms and it can be plugged into any 115 VAC outlet.

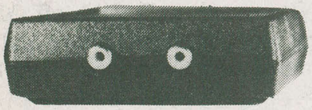
The unit features a front-loading deck with still, fine still tuning, tracking, frame-by-frame forward, five-times speed search, auto repeat, 6-hour timer, and external video and audio connections.

The Movie-Box is ideal for sales meetings, in-store demonstrations, instructional sessions, school programs, etc. The list price of the Movie-Box is $995.

For more information contact:
Jim Breedon, Lenline Electronics Ltd., 60 Minuk Acres, Scarborough, Ontario M1E 4Y6 (416) 286-7470.

## DIGITAL VIDEO STABILIZER

ELIMINATES ALL VIDEO COPYGUARDS



While watching rental movies, you will notice annoying periodic color darkening, color shift, unwanted lines, flashing or jagged edges. This is caused by the copy protection jamming signals embedded in the video tape, such as Macrovision copy protection. Digital Video Stabilizer: RXII completely eliminates all copy protections and jamming signals and brings you crystal clear pictures.

### WARNING

SCO Electronics and RXII dealers do not encourage people to use the Digital Video Stabilizer to duplicate rental movies or copyrighted video tapes. RXII is intended to stabilize and restore crystal clear picture quality for private home use only.

### FEATURES

- Easy to use and a snap to install
- State-of-the-art integrated circuit technology
- 100% automatic - no need for any troublesome adjustments
- Compatible to all types of VCRs and TVs
- The best and most exciting Video Stabilizer in the market
- Light weight (8 ounces) and Compact (1x3.5x5")
- Beautiful deluxe gift box
- Uses a standard 9 Volt battery which will last 1-2 years.
- 1 year warranty

| QTY. | 1 | 6 | 12 |
|---|---|---|---|
| PRICE | $99 | $95 | $89 |

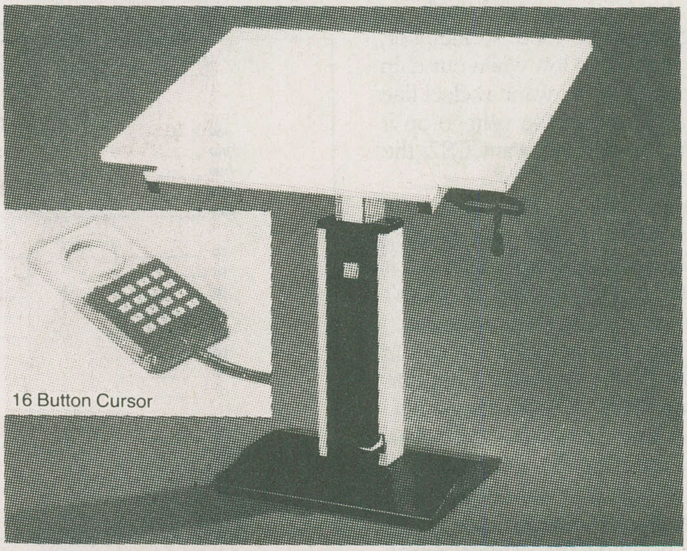
SEND CHEQUE OR MONEY ORDER TO:

**IMAGE 2000**

P.O. BOX 3875, STN. D, EDMONTON
ALBERTA T5L 4K1
ALLOW 2—4 WEEKS FOR DELIVERY
DEALER ENQUIRIES WELCOME!

## HI-STATE DESK-TOP DIGITIZER

OEM MODEL HS-241-IE

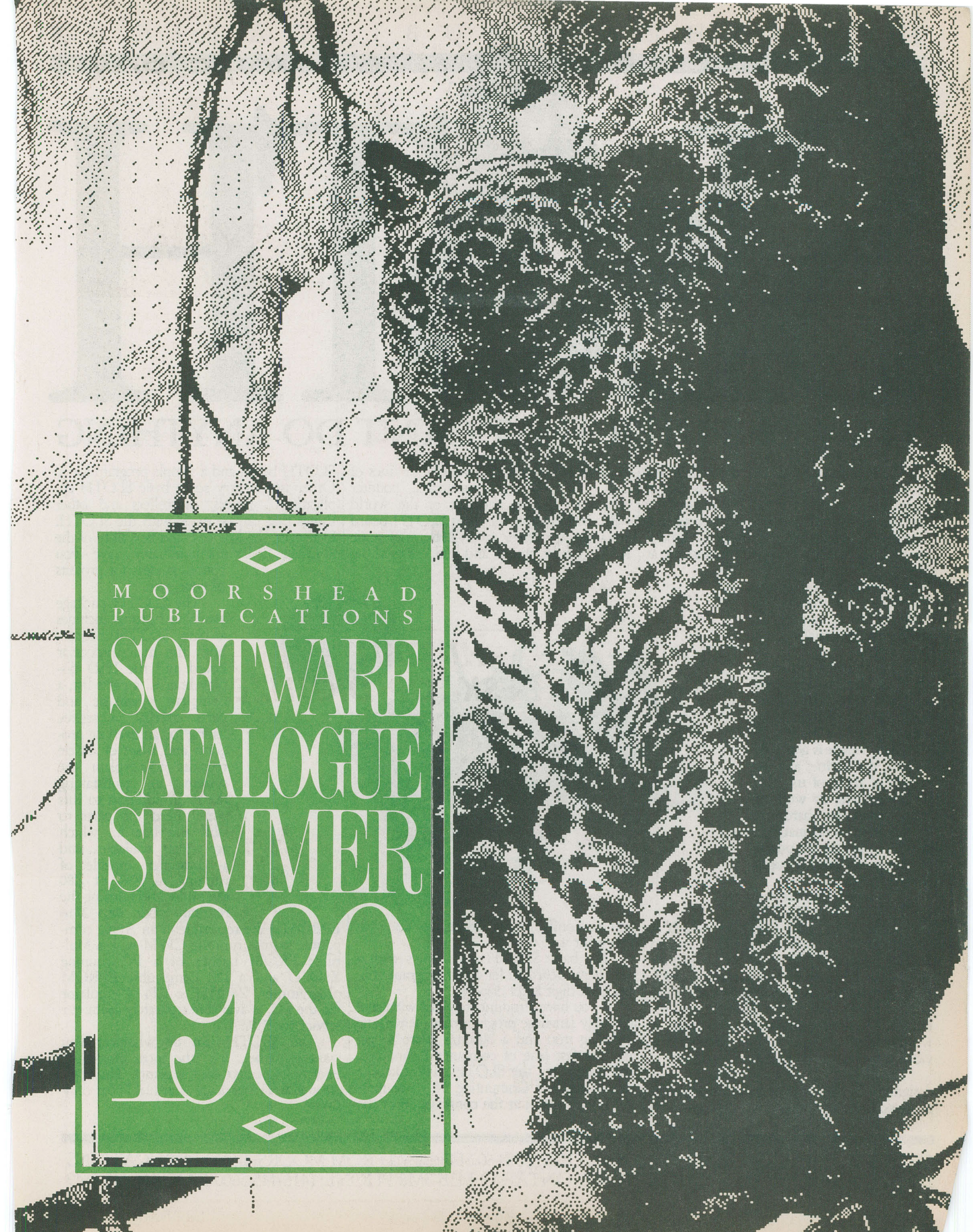



Manual Pedestal Option Shown - Model TF-20 above

SPECIAL OFFER

**Specifications:** Working area 24" x 36"; Resolution .001"; CSA Power Supply; Line Cord; 16 Button Cursor; Cursor Holder; AC30 Controller; Operator's Handbook; Menu Label; RS232 Cable Terminated for IBM PC, XT or AT.

Gentian Electronics Ltd.
P.O. BOX 1240, STITTSVILLE, ONTARIO K0A 3G0
TEL. (613) 836-3987



MOORSHEAD PUBLICATIONS

# SOFTWARE CATALOGUE SUMMER 1989

# SLTH

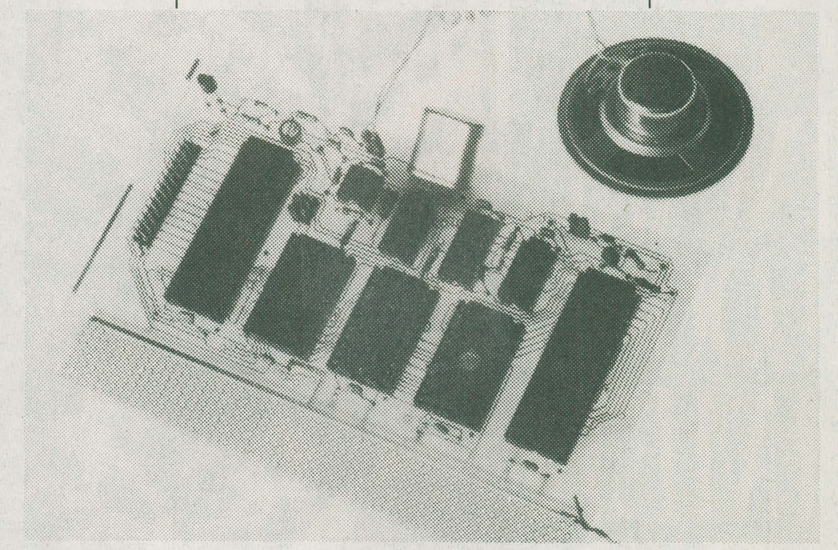
## THE COMPUTER THAT CAN'T DO ANYTHING

Computers can do a lot more than just manage data bases and play video games. Specialized microprocessor boards can be used as programmable frequency counters, intelligent temperature controllers, timers, monitors... dedicated microcomputers are at the heart of most of the sophisticated high tech toys that make our lives exciting and our bank balances so easily managed with just a few fingers.

Unfortunately, most individual humans donn't get to work with small, board level micros. These things usually have to be custom designed, which is generally beyond the abilities and the means of most of us. This is unfortunate, as working with computer hardware at this level is fascinating... and can give one the power to create unspeakably sophisticated projects.

This is why we created the SLOTH. The SLOTH is a small Z80 based computer which is designed to be turned into things. It has no screen, keyboard, floppy disks or printer port... but it's easy to get parts for, quick to assemble and painless to program. It has powerful I/O facilities to allow you to interface it to anything you want to make it work with, from the remote control of a video recorder to the ignition of your car.

The SLOTH isn't a trainer... it's designed to be built up into working projects. It's programmed with inexpensive 2716 EPROMs. It has twenty-four lines of I/O and three programmable counter timers to talk to the rest of the world with. Included on the main SLOTH board are a speaker driver, two kilobytes of static RAM, a pulse source and jumpers to allow you to configure the system to do what you want it to do.



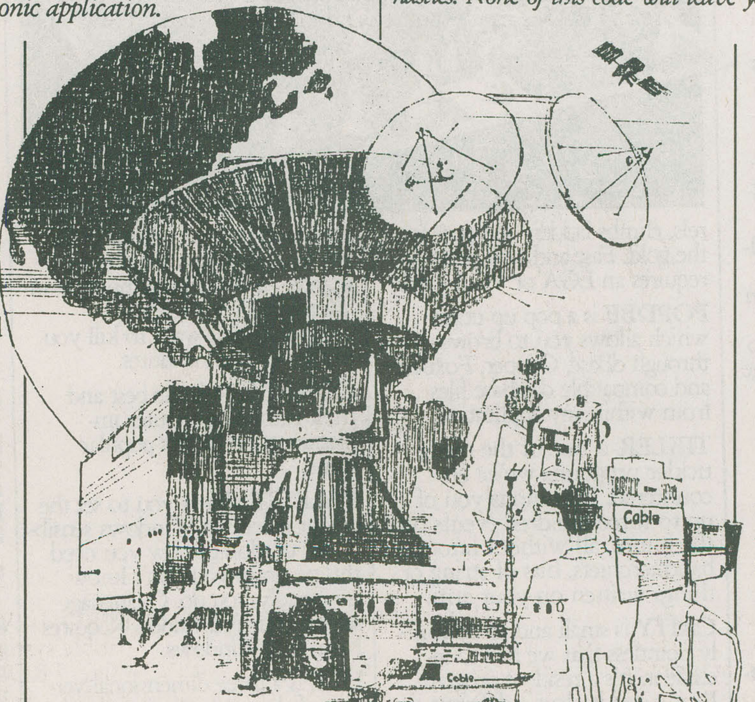
The basic SLOTH also comes with a peripheral board to let one's program control a six digit LED display.

If you have a rudimentary knowledge of assembly language programming, a working soldering iron and a burning desire to get into the fast lane of computer technology, you should try the SLOTH. The October 1986 edition of Computing Now! features an extensive look at the construction of the SLOTH board and a sample program for it. Other issues carry some basic SLOTH applications... timers, controllers and other things that can be made with the SLOTH. However, the low cost and flexibility of the SLOTH will unquestionably give you countless ideas for projects of your own.

The SLOTH package available from us includes a bare SLOTH board... both the main processor board and the LED display board... a parts list, a complete schematic and parts overlay, a source listing for an exercise program and a set of article reprints to explain the system in painstaking detail. In addition to this you'll need the parts to stuff the board... which are widely available... and a computer capable of running an 8080 or Z80 assembler and burning the resultant code into 2716 EPROMs. We recommend an Apple compatible system running CP/M with a Multiflex PROM burner or a PC running Z80MU and a PC compatible EPROM programmer. Z80MU, a CP/M emulator for the PC, is available separately from our service for $19.95.

The SLOTH can be whatever you want it to be... it's the most interesting electronics project on the planet. The complete SLOTH package is available for only $37.95.

ORDER THE SLOTH FOR $37.95 (PLUS 8% O.S.T. & $1.50 SHIPPING FROM MOORSHEAD PUBLICATIONS 1300 DON MILLS ROAD, NORTH YORK, ONTARIO M3B 3M8 PHONE: (416)445-5600 FAX: 416-445-8149


Cable
Cable

MOORSHEAD PUBLICATIONS

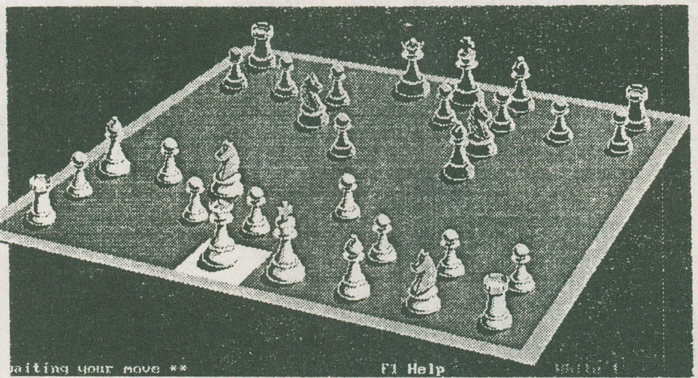
# ALMOST FREE™ SOFTWARE

## VOLUME FORTY-NINE

*This month, we wanted to say 'thanks' to everyone who'se bought our Almost Free Software collections thus far, so we created a special collection of programs. This month, we've put together a two disk set... over a megabyte of software when it's all unpacked... but the price is the same as it always was for a single volume. It's our way of telling you how much we appreciate your support of our software.*

*It's summer, and no one really wants to work all that hard. As such, this month's collection does lean a little heavily toward recreation. There are a few serious applications, such as the incredible mailing list and label program, the dBase file browser, the tickler and the phone number directory for Windows, but there are also a lot of really stupendous games. You won't believe your senses when you try Aldo, Fans, Chess and Tri-Maze, to name but a few. There's a whole lot more in this month's collection.*

*Every program on this disk has been extensively checked to make sure that it functions as it should and that it contains no viruses or other nasties. Most sources of public domain software do not provide you with this assurance. This disk carries the same promise that all our Almost Free Software does. If you don't feel that it's fair value once you've checked it out, we'll buy it back from you with no gripes or questions. If you have problems with it, our help desk is as near as your phone... just call (416) 445-5600. If you're not already receiving it, please call us and ask to be put on the mailing list of Personal Software News, our newsletter. It's free.*




**PHONES** is a Windows application which keeps track of telephone numbers... it'll even dial 'em for you if you have a modem attached to your system. Requires Microsoft Windows. This one is a gem.

**BRAIN** asks you a lot of peculiar questions and evaluates how much of your thought processes are left brain, how much are right brain and how much are mixed brain. Not immediately useful, but interesting. Requires a brain.

**LM** is the absolutely best mailing list program and label maker ever written. If you run a small business or just send out a club news letter every so often, this program will change your perception of the universe. dBase compatible.

**ONEKEY** is a small, elegant keyboard macro program. It stores up to fifty strings, each one callable with the key combination of your choice. Ends buckets of repetitious typing. This is especially handy for Ventura users who precode their text. ALDO is a game in the tradition of Mario Brothers. A little fellow with a beard... could be a pizza delivery man, could be a leprechaun... leaps over barrels, climbs ladders and goes for the gold. Fast and well done, it requires an EGA or VGA card.

**POPDBF** is a pop up utility which allows you to browse through dBase, Clipper, Foxbase and compatible database files from within any application.

**TIKLER** is one of the nicest tickler programs we've encountered. It reminds you of up to three hundred events on the future, all without knotted handkerchiefs, bits of string or things written on your arm.

**CAITY** is small and so brilliantly pointless that we had to include it. It's a resident program. Run it and it plays a different musical note for every key on your keyboard as you run other applications. It's a delight to listen to as you type DOS commands... a veritable symphony in WordStar. Your fellow employees will want to kill you inside of fifteen minutes.

**CONNECT4** is the best and most ruthless computer implementation of this popular game.

**PALETTE** allows you to set the colour palette in Windows sensibly. If you don't know you need this program you don't know how badly you do. C language source code is included. Requires Microsoft Windows.

**LIFE** is a three dimensional version of the now classic program. Watch a colony of creatures lunch out on each other. Primary a programmer's toy, the C language source code is included.

**TRI-MAZE** is a blast. It draws mazes and then challenges you to solve them. The mazes can be mercilessly complex, and the game gives you ample tools to help you navigate them.

**PERIODIC** is a brilliant bit of work. It displays the periodic table and lets you scan a cursor over it to get detailed information about each element. Ever wake up wondering about the atomic weight of Iridium? Happens to all of us sooner or later. Requires an EGA or VGA card.

**FANS** is actually supposed to be an EGA demo for a graphics library, but it's so fast and so good that we've included it here. It's actually a game in which you pilot a space ship through a field of waving fans catching bouncing loonie dollars as you go. No foolin'... An EGA or VGA card is required.

**CHESS** will hurt your brain. This is a three dimensional chess game which plays a wicked game and actually allows you to move the pieces around, rather than just typing in co-ordinates. This has to be the last word in computer chess. Requires an EGA or VGA card.

FINE PRINT: This software has been collected from public access bulletin boards and/or has been placed directly in the public domain by its authors. It is all believed to be in the public domain, or offered as "shareware". As shareware, users of these programs are requested to pay registration fees to their authors, which may entitle you to additional updates, support and documentation. Note that the fee charged for this disk defers our cost in collecting and distributing the software only, it does not replace any requested shareware contributions. This will help to ensure a continuing supply of high quality shareware available at reasonable prices. If you try out this disk, and do not feel that it is fair value, you may return it for a refund or exchange it for a different disk with no questions asked. We do not sell software to people who cannot use it. If you have trouble with disk, you are welcome to call our free technical support service at (416) 445-5600 during normal business hours. Please be prepared to tell us the exact make and model of your computer and the disk and program you are having difficulty with. Please note that we cannot be respnsible for any loss, damage or expense resulting from your use of this software, however caused.If you are unable to read your disk, it has probably been corrupted in the mail. You need not call us in this case. Simply return the disk to our software department with a note requesting a replacement. It will be shipped immediately. Please note that this disk does presuppose a reasonable familiarity with your computer. If you are very new to your system, we strongly recommend that you familiarize yourself with it before attempting to use almost free software.

DISKS ONLY $19.95 EACH (PLUS 8% O.S.T. & $1.50 SHIPPING) FROM MOORSHEAD PUBLICATIONS
1300 DON MILLS ROAD, TORONTO, ONTARIO M3B 3M8 PHONE: (416)445-5600 FAX: 416-445-8149
*PLEASE SPECIFY 5 1/4 INCH DISKETTES OR 3 1/2 INCH MICROFLOPPIES*

M O O R S H E A D   P U B L I C A T I O N S

# ALMOST FREE™ SOFTWARE

## V O L U M E 5 0

*This month, we wanted to say 'thanks' to everyone who's bought our Almost Free Software collections thus far, so we created a special collection of programs. This month, we've put together a two disk set... over a megabyte of software when it's all unpacked. However, the price only reflects the cost of one extra blank floppy and a few stamps. It's our way of telling you how much we appreciate your support of our software.*

*This month's collection of programs is diverse. It includes such things as a set of desktop publishing text ornaments, a couple of first class weird games and some utilities you won't want to be without. For those users with more karma than things to do, we've also included CUBE, our all time favourite useless Windows program.*

*And there's a whole lot more in this month's collection.*

*Every program on this disk has been extensively checked to make sure that it functions as it should and that it contains no viruses or other nasties. Most sources of public domain software do not provide you with this assurance. This disk carries the same promise that all our Almost Free Software does. If you don't feel that it's fair value once you've checked it out, we'll buy it back from you with no gripes or questions.*

*If you have problems with it, our help desk is as near as your phone... just call (416) 445-5600. If you're not already receiving it, please call us and ask to be put on the mailing list of Personal Software News, our newsletter. It's free.*

BAK will wander through your entire hard drive... every subdirectory, no matter how well buried it might be... and wipe out your BAK files. Reclaim countless megabytes of wasted space.

CHAIN will tell you how much space any file on your disk occupies. This sounds like much ado about nothing, but CHAIN actually tells you how many clusters a file occupies, and, for the technically curious, where said clusters lie.

CUBE is a useless program that runs under Windows and displays a constantly rotating three dimensional cube. Despite its uselessness, everyone we know who has it runs it a lot... no idea why. Requires Windows.

DUNGEON is an ASCII game that lets you cruise through a complex, multiple layer dungeon picking up things and killing creatures. Requires that ANSI.SYS be installed.

IBM_SCRN is a downloadable character set for the Epson FX printers... and all compatibles... which emulates the PC's screen graphics characters. Make your screen dumps look like screen dumps rather than ASCII stew.

JOT-IT is the most flexible, interesting little resident note pad program we've come across. Loaded with features, it will find a warm place on your hard drive... right next to the platter bearings.

MINDREADER is the oddest word processor ever written. Especially designed for people who don't type too quickly, it uses artificial intelligence to attempt to anticipate what you'll say and fill in things for you. It sounds a bit far fetched, but the beast works.

POSTGIF is the latest version of this powerful program for turning GIF files into desktop publishing clip art. Now features variable size halftone screens for better reproduction.

PURGE is a handy little utility for selectively deleting files.

QCRT will speed up the screen speed of most machines by quite a bit. This makes DOS and many other programs which print through the BIOS really shift into overdrive.

SLITHER is a version of the popular snake game written especially for the EGA card. It's a bit warped, too... there's a frog involved. Requires an EGA or VGA card.

SPEED will speed up the screen display of an EGA or VGA card even better than QCRT, above. Includes the ASM source in case you like to hack.

CHEMVIEW is neat even if chemistry usually bores you into catatonia. It displays complex molecules in three dimensions and rotates them for you. Includes sample molecules. Requires EGA or VGA card.

FONTINFO is a DIR replacement that only wants to know about LaserJet soft fonts. It will find all of the soft fonts in a directory and tell you about them.

DROPCAPS consists of twenty six little PCX files, that can be inhaled into Ventura, PageMaker... any package that uses the popular PC Paintbrush image file format... to provide you with beautiful, ornate large caps from A through Z.

THESAURUS is a computerized thesaurus program. Give it a word and it'll find you a selection of others that mean something like the same thing. Includes a huge dictionary.

FINE PRINT: This software has been collected from public access bulletin boards and/or has been placed directly in the public domain by its authors. It is all believed to be in the public domain, or offered as "shareware". As shareware, users of these programs are requested to pay registration fees to their authors, which may entitle you to additional updates, support and documentation. Note that the fee charged for this disk defers our cost in collecting and distributing the software only, it does not replace any requested shareware contributions. This will help to ensure a continuing supply of high quality shareware available at reasonable prices. If you try out this disk, and do not feel that it is fair value, you may return it for a refund or exchange it for a different disk with no questions asked. We do not sell software to people who cannot use it. If you have trouble with disk, you are welcome to call our free technical support service at (416) 445-5600 during normal business hours. Please be prepared to tell us the exact make and model of your computer and the disk and program you are having difficulty with. Please note that we cannot be respnsible for any loss, damage or expense resulting from your use of this software, however caused.If you are unable to read your disk, it has probably been corrupted in the mail. You need not call us in this case. Simply return the disk to our software department with a note requesting a replacement. It will be shipped immediately. Please note that this disk does presuppose a reasonable familiarity with your computer. If you are very new to your system, we strongly recommend that you familiarize yourself with it before attempting to use almost free software.

DISKS ONLY $19.95 EACH (PLUS 8% O.S.T. & $1.50 SHIPPING) FROM MOORSHEAD PUBLICATIONS
1300 DON MILLS ROAD, TORONTO, ONTARIO M3B 3M8 PHONE: (416)445-5600 FAX: 416-445-8149
*PLEASE SPECIFY 5 1/4 INCH DISKETTES OR 3 1/2 INCH MICROFLOPPIES*

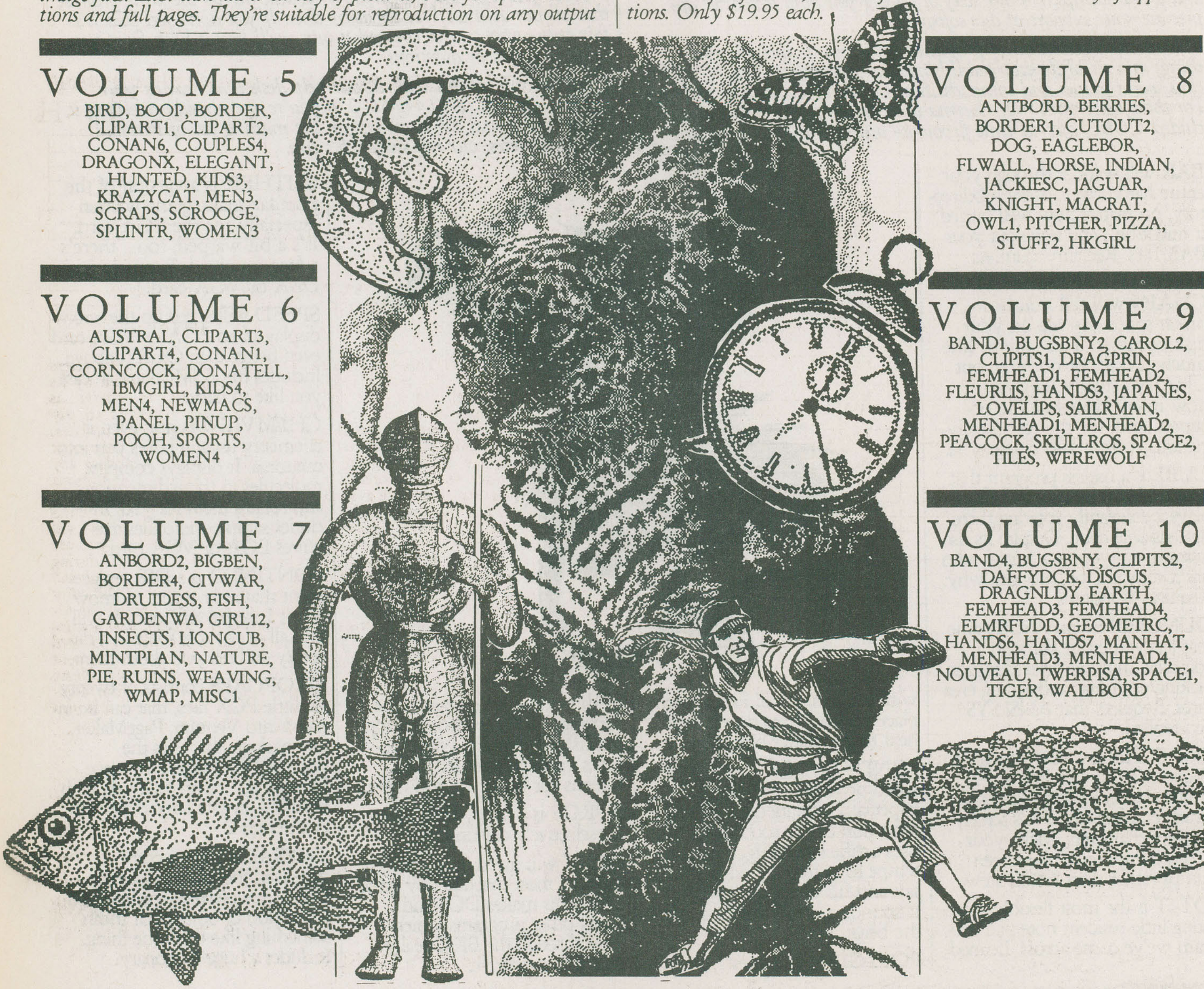
M O O R S H E A D   P U B L I C A T I O N S

# CLIPART

## FOR PC/XT/AT AND MACINTOSH

*Digital ClipArt is the spice of desktop publishing. However, unless you have a scanner and a ready source of hard copy clipart at your disposal, you'll have a hard time amassing a library of images. At least, it used to be.*

*Almost Free Ventura ClipArt picture collections are disks full of image files. Each disk has a variety of pictures, both for spot illustrations and full pages. They're suitable for reproduction on any output device. Almost free clip art now supports Ventura Publisher, Aldus PageMaker and WordPerfect 5. In fact, it is compatible with almost all desktop publishing packages, paint programs and word processors which accept graphic files. Each disk comes with a utility to convert the clipart to MacPaint, GEM/IMG, PC Paintbrush PCX and PCC and TIFF file formats, suitable for use with a wide variety of applications. Only $19.95 each.*



## VOLUME 5

BIRD, BOOP, BORDER, CLIPART1, CLIPART2, CONAN6, COUPLES4, DRAGONX, ELEGANT, HUNTED, KIDS3, KRAZYCAT, MEN3, SCRAPS, SCROOGE, SPLINTR, WOMEN3

## VOLUME 6

AUSTRAL, CLIPART3, CLIPART4, CONAN1, CORNCOCK, DONATELL, IBMGIRL, KIDS4, MEN4, NEWMACS, PANEL, PINUP, POOH, SPORTS, WOMEN4

## VOLUME 7

ANBORD2, BIGBEN, BORDER4, CIVWAR, DRUIDESS, FISH, GARDENWA, GIRL12, INSECTS, LIONCUB, MINTPLAN, NATURE, PIE, RUINS, WEAVING, WMAP, MISC1

## VOLUME 8

ANTBORD, BERRIES, BORDER1, CUTOUT2, DOG, EAGLEBOR, FLWALL, HORSE, INDIAN, JACKIESC, JAGUAR, KNIGHT, MACRAT, OWL1, PITCHER, PIZZA, STUFF2, HKGIRL

## VOLUME 9

BAND1, BUGSBNY2, CAROL2, CLIPITS1, DRAGPRIN, FEMHEAD1, FEMHEAD2, FLEURLIS, HANDS3, JAPANES, LOVELIPS, SAILRMAN, MENHEAD1, MENHEAD2, PEACOCK, SKULLROS, SPACE2, TILES, WEREWOLF

## VOLUME 10

BAND4, BUGSBNY, CLIPITS2, DAFFYDCK, DISCUS, DRAGNLDY, EARTH, FEMHEAD3, FEMHEAD4, ELMRFUDD, GEOMETRC, HANDS6, HANDS7, MANHAT, MENHEAD3, MENHEAD4, NOUVEAU, TWERPISA, SPACE1, TIGER, WALLBORD

FINE PRINT: This software has been collected from public access bulletin boards and/or has been placed directly in the public domain by its authors. It is all believed to be in the public domain, or offered as "shareware". As shareware, users of these programs are requested to pay registration fees to their authors, which may entitle you to additional updates, support and documentation. Note that the fee charged for this disk defers our cost in collecting and distributing the software only, it does not replace any requested shareware contributions. This will help to ensure a continuing supply of high quality shareware available at reasonable prices. If you try out this disk, and do not feel that it is fair value, you may return it for a refund or exchange it for a different disk with no questions asked. We do not sell software to people who cannot use it. If you have trouble with disk, you are welcome to call our free technical support service at (416) 445-5600 during normal business hours. Please be prepared to tell us the exact make and model of your computer and the disk and program you are having difficulty with. Please note that we cannot be respnsible for any loss, damage or expense resulting from your use of this software, however caused.If you are unable to read your disk, it has probably been corrupted in the mail. You need not call us in this case. Simply return the disk to our software department with a note requesting a replacement. It will be shipped immediately. Please note that this disk does presuppose a reasonable familiarity with your computer. If you are very new to your system, we strongly recommend that you familiarize yourself with it before attempting to use almost free software.

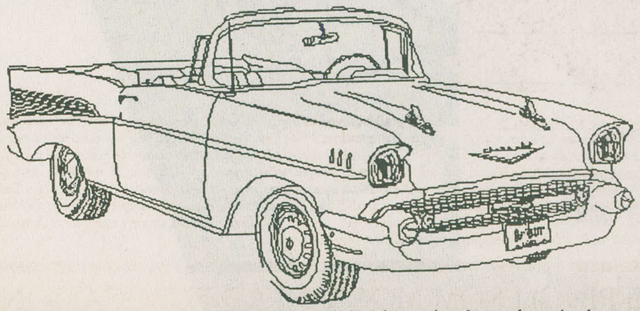
DISKS ONLY $19.95 EACH (PLUS 8% O.S.T. & $1.50 SHIPPING) FROM MOORSHEAD PUBLICATIONS
1300 DON MILLS ROAD, TORONTO, ONTARIO M3B 3M8 PHONE: (416)445-5600 FAX: 416-445-8149

*PLEASE SPECIFY 5 1/4 INCH DISKETTES OR 3 1/2 INCH MICROFLOPPIES*

# SOFTWARE CATALOGUE ORDER FORM

## SOFTWARE

| PC/MS-DOS | PRICE | QTY | AMOUNT |
|---|---|---|---|
| Almost Free PC Volume 1 (AFSPC1) | $19.95 | | |
| Almost Free PC Volume 2 (AFSPC2) | $19.95 | | |
| Almost Free PC Volume 3 (AFSPC3) | $19.95 | | |
| Almost Free PC Volume 4 (AFSPC4) | $19.95 | | |
| Almost Free PC Volume 5 (AFSPC5) | $19.95 | | |
| Almost Free PC Volume 6 (AFSPC6) | $24.95 | | |
| Almost Free PC Volume 7 (AFSPC7) | $19.95 | | |
| Almost Free PC Volume 8 (AFSPC8) | $24.95 | | |
| Almost Free PC Volume 9 (AFSPC9) | $19.95 | | |
| Almost Free PC Volume 10 (AFSPC10) | $19.95 | | |
| Almost Free PC Volume 11 (AFSPC11) | $19.95 | | |
| Almost Free PC Volume 12 (AFSPC12) | $19.95 | | |
| Almost Free PC Volume 14 (AFSPC13) | $19.95 | | |
| Almost Free PC Volume 15 (AFSPC15) | $19.95 | | |
| Almost Free PC Volume 16 (AFSPC16) | $19.95 | | |
| Almost Free PC Volume 17 (AFSPC17) | $19.95 | | |
| Almost Free PC Volume 18 (AFSPC18) | $19.95 | | |
| Almost Free PC Volume 19 (AFSPC19) | $19.95 | | |
| Almost Free PC Volume 20 (AFSPC20) | $19.95 | | |
| Almost Free PC Volume 21 (AFSPC21) | $19.95 | | |
| Almost Free PC Volume 22 (AFSPC22) | $19.95 | | |
| Almost Free PC Volume 23 (AFSPC23) | $29.95 | | |
| Almost Free PC Volume 24 (AFSPC24) | $19.95 | | |
| Almost Free PC Volume 25 (AFSPC25) | $19.95 | | |
| Almost Free PC Volume 26 (AFSPC26) | $19.95 | | |
| Almost Free PC Volume 27 (AFSPC27) | $19.95 | | |
| Almost Free PC Volume 28 (AFSPC28) | $19.95 | | |
| Almost Free PC Volume 29 (AFSPC29) | $19.95 | | |
| Almost Free PC Volume 30 (AFSPC30) | $19.95 | | |
| Almost Free PC Volume 31 (AFSPC31) | $19.95 | | |
| Almost Free PC Volume 32 (AFSPC32) | $19.95 | | |
| Almost Free PC Volume 33 (AFSPC33) | $19.95 | | |
| Almost Free PC Volume 34 (AFSPC34) | $19.95 | | |
| Almost Free PC Volume 35 (AFSPC35) | $19.95 | | |
| Almost Free PC Volume 36 (AFSPC36) | $19.95 | | |
| Almost Free PC Volume 37 (AFSPC37) | $19.95 | | |
| Almost Free PC Volume 38 (AFSPC38) | $19.95 | | |
| Almost Free PC Volume 39 (AFSPC39) | $19.95 | | |
| Almost Free PC Volume 40 (AFSPC40) | $19.95 | | |
| Almost Free PC Volume 41 (AFSPC41) | $19.95 | | |
| Almost Free PC Volume 42 (AFSPC42) | $19.95 | | |
| Almost Free PC Volume 43 (AFSPC43) | $19.95 | | |
| Almost Free PC Volume 44 (AFSPC44) | $19.95 | | |
| Almost Free PC Volume 45 (AFSPC45) | $19.95 | | |
| Almost Free PC Volume 46 (AFSPC46) | $19.95 | | |
| Almost Free PC Volume 47 (AFSPC47) | $19.95 | | |
| Almost Free PC Volume 48 (AFSPC48) | $19.95 | | |
| Almost Free PC Volume 49 (AFSPC49) | $24.95 | | |
| Almost Free PC Volume 50 (AFSPC50) | $19.95 | | |
| Hard Disk Survival Kit (AFSHD) | $19.95 | | |
| Almost Free Business Software (BUSN1) | $19.95 | | |
| Ventura Survival Disk Volume 1 (AFVENT1) | $19.95 | | |
| SuperDisk Volume 1 (utilities) (SD1) | $19.95 | | |
| SuperDisk Volume 2 (games) (SD2) | $19.95 | | |
| SuperDisk Volume 3 (dBase utilities) (SD3) | $19.95 | | |
| SuperDisk Volume 4 (utilities) (SD4) | $19.95 | | |
| SuperDisk Volume 5 (business) (SD5) | $19.95 | | |
| SuperDisk Volume 6 (games) (SD6) | $19.95 | | |
| SuperDisk Volume 7 (games) (SD7) | $19.95 | | |
| SuperDisk Volume 8 (productivity) (SD8) | $19.95 | | |
| SuperDisk Volume 9 (1-2-3 utilies) (SD9) | $19.95 | | |
| Leisure Library Volume 1 (LL1) | $19.95 | | |
| Leisure Library Volume 2 (LL2) | $19.95 | | |
| Leisure Library Volume 3 (LL3) | $19.95 | | |
| LaserJet Fonts Volume 1 (AFLJ1) | $19.95 | | |
| Games Disk Volume 1 (AFGAMES1) | $19.95 | | |
| Games Disk Volume 2 (AFGAMES2) | $19.95 | | |
| Games Disk Volume 3 (AFGAMES3) | $19.95 | | |
| Executive Software Series Volume 1 (EXEC1) | $19.95 | | |
| Executive Software Series Volume 2 (EXEC2) | $19.95 | | |
| Executive Software Series Volume 3 (EXEC3) | $19.95 | | |
| Executive Software Series Volume 4 (EXEC4) | $19.95 | | |
| Executive Software Series Volume 5 (EXEC5) | $19.95 | | |
| Executive Software Series Volume 6 (EXEC6) | $19.95 | | |
| Executive Software Series Volume 7 (EXEC7) | $24.95 | | |
| Executive Software Series Volume 8 (EXEC8) | $19.95 | | |
| Electronics & Technology Series Volume 1 (ETT1) | $19.95 | | |
| Almost Free DX-7 Voices (AFDX7) | $19.95 | | |



FORMAT: ______ 5.25" disks will be shipped unless otherwise instructed.

## CLIPART

| TITLE | PRICE | QTY | AMOUNT |
|---|---|---|---|
| Specify PC or Macintosh format: | | | |
| Ventura ClipArt Volume 1 (AFCLIP1) | $19.95 | | |
| Ventura ClipArt Volume 2 (AFCLIP2) | $19.95 | | |
| Ventura ClipArt Volume 3 (AFCLIP3) | $19.95 | | |
| Ventura ClipArt Volume 4 (AFCLIP4) | $19.95 | | |
| Ventura ClipArt Volume 5 (AFCLIP5) | $19.95 | | |
| Ventura ClipArt Volume 6 (AFCLIP6) | $19.95 | | |
| Ventura ClipArt Volume 7 (AFCLIP7) | $19.95 | | |
| Ventura ClipArt Volume 8 (AFCLIP8) | $19.95 | | |
| Ventura ClipArt Volume 9 (AFCLIP9) | $19.95 | | |
| Ventura ClipArt Volume 10 (AFCLIP10) | $19.95 | | |
| LaserArt Volume 1 (AFLASER1) | $19.95 | | |
| COLOUR CLIPART | | | |
| Volume 1 GIF® Images (specify format)* (AFGIF1) | $19.95* | | |
| PC PaintBrush® Comp. (specify format)* (AFPCX1) | $29.95* | | |
| Volume 2 GIF® Images (specify format)* (AFGIF2) | $19.95* | | |
| Volume 3 GIF® Images (specify format)* (AFGIF3) | $19.95* | | |
| Volume 4 GIF® Images (specify format)* (AFGIF4) | $19.95* | | |

**On 1.2 megabyte disks. $31.95 on dual density 360K disks*

## MACINTOSH

| | | | |
|---|---|---|---|
| Almost Free Macintosh Volume 1 (AFMAC1) | $24.95 | | |
| Almost Free Macintosh Volume 2 (AFMAC2) | $24.95 | | |
| Almost Free Macintosh Volume 3 (AFMAC3) | $24.95 | | |
| Almost Free Macintosh Volume 4 (AFMAC4) | $24.95 | | |
| Almost Free Macintosh Volume 5 (AFMAC5) | $24.95 | | |
| Almost Free Macintosh Volume 6 (AFMAC6) | $24.95 | | |
| PostScript Laser Fonts Volume 1 (AFMACPSF1) | $24.95 | | |

| | |
|---|---|
| SUBTOTAL: | |
| 8% P.S.T. (Ontario residents): | |
| POSTAGE & HANDLING ($1.50): | |
| TOTAL: | |

**CUSTOMERPOLICY:** This software has been collected from public access bulletin boards and/or has been placed directly in the public domain by its authors. It is all believed to be in the public domain, or offered as "shareware". As shareware, users of these programs are requested to pay registration fees to their authors, which may entitle you to additional updates, support and documentation. Note that the fee charged for this disk defers our cost in collecting and distributing the software only, it does not replace any requested shareware contributions. This will help to ensure a continuing supply of high quality shareware available at reasonable prices. If you try out this disk, and do not feel that it is fair value, you may return it for a refund or exchange it for a different disk with no questions asked. We do not sell software to people who cannot use it. If you have trouble with disk, you are welcome to call our free technical support service at (416) 445-5600 during normal business hours. Please be prepared to tell us the exact make and model of your computer and the disk and program you are having difficulty with. Please note that we cannot be respnsible for any loss, damage or expense resulting from your use of this software, however caused.If you are unable to read your disk, it has probably been corrupted in the mail. You need not call us in this case. Simply return the disk to our software department with a note requesting a replacement. It will be shipped immediately. Please note that these disks do presuppose a reasonable familiarity with your computer. If you are very new to your system, we strongly recommend that you familiarize yourself with it before attempting to use this software.

NAME ______________________

COMPANY ______________________

ADDRESS ______________ CITY ______________

PROVINCE ______________ POSTAL CODE ______________

PHONE ______________ SUBSCRIBER? ☐CN! ☐ETT ☐CIE

☐ CHEQUE ENCLOSED ☐ PLEASE CHARGE MY:

☐ VISA ☐ AMERICAN EXPRESS ☐ MASTERCARD

CARD NUMBER ______________________

EXPIRY DATE ______________________

SIGNATURE ______________________

SEND TO:
MOORSHEAD PUBLICATIONS
1300 Don Mills Road, North York, Ontario M3B 3M8
(416)445-5600 FAX: 416-445-8149.

# THE SCIENTISTS TELL ME

DAVID P. DEMPSTER

## Super-Sophisticated Sensors Make Sense

Some time within the next three years or so we could be seeing something quite new and different in the field of optical sensors. That's the time frame that researchers at the University of Toronto's Department of Chemistry have targeted for the commercialization of their most interesting development.

Professor Ulrich Krull and colleagues with the Chemical Sensors Group are working on a prototype sensing device the shape and size of a pen. It contains optical sensors and computer chips and could one day be used to detect everything from toxins in drinking water to bombs at airports – almost instantly, without any need for special skills or expertise.

"The devices would work much faster and be less costly than chemical analyses that are now used to detect industrial pollutants, narcotics and explosives," Krull said. "We've already developed optical sensors that detect various toxins and environmental contaminants. This tells us that the technology works in principle and can be adapted for a wide range of applications."

Krull's optical sensors consist of thin quartz cylinders coated with membranes containing light-sensitive chemical receptors. They work on the principle that chemical interactions can cause light to take on distinctive characteristics – to reveal optical fingerprints, in effect.

To detect a bomb hidden in a suitcase, for example, the sensing device would be held over the luggage for a few seconds. Traces of chemicals from the bomb, emitted into the air, would contact the quartz cylinder and interact with the chemical receptors in the membrane coating.

AT the same time, a laser beam would be generated inside the device and directed at the cylinder. The interaction between the chemical receptors and the chemicals in the air would cause certain properties of the laser beam (e.g. intensity, wavelength) to change. The device's computer processor would then compare the changes to those that would have been produced by the targeted explosive. A match would indicate that the explosive was in the suitcase.

Nor does it end there. Among the more interesting potential applications is the use of the detector in the field of medicine. The same principle would apply to detecting many other substances, including ones in the body that signal the presence of diseases, such as cancer. Different combinations of chemical receptors would be used for each application. The rest of the device would require no changes.

And because of its versatility, it could likely find a niche in the food, dairy, pharmaceutical and packaging industries to ascertain the presence of off-spec or contaminated materials.

In fact, Professor Krull has an application for funding before Agriculture Canada and is already receiving financial support from National Defence.

## The Cards are Smart

By the time the mid-1990s roll along there will be millions of North Americans using "smart cards" to tackle a wide range of jobs. So versatile will these cards be that they will be able to store medical records on army dog tags, (the Ontario Ministry of Health is actually promoting a related scheme for its citizens to give the government more control over health expenditures), record toll collections on highways and bridges, public transit passes, and track crops and animals on the farm, to mention just a few of the numerous applications forthcoming. These cards, also known as portable data carriers (PDC), may be in the form of credit cards, keys, tags, cassettes, and cartridges, according to B. J. Brownstein, manager of Battelle's Electronic Systems and Technology Department, and R. D. Rosen, manager of the Electronic Products Development Section at Battelle. Battelle is a leading international technology development organization. And what of the future for these smart cards?

According to Brownstein and Rosen, less than a decade ago, there were only three firms in the (smart card) business. Now, nearly every major electronics company in the world has entered this business in one way or another.

First introduced in France in the early 1980s, smart cards generally have three basic traits:

*The Selsdon oil filter described in the text adds another section to treat the bypass oil, improving the purity of the oil and increasing the time between oil changes.*

* an easily portable package;
* a means for transferring data to and from outside sources; and
* a way to retain the contents of its memory without an external power source.

Battelle has been extensively involved in PDC technology for several years, conducting more than 40 programs ranging from market studies to developing and integrating entire PDC-based resource management systems and support equipment.

What are some of the characteristics that fit PDC technology? According to Battelle specialists, these are:

* individual items that must be tracked in the field;
* data must be carried directly with the item;
* a solution using on-line networks does not seem feasible; or
* in-place technology, standards or investments do not influence the selection of newer technology.

These generic characteristics exist in many potential applications, say the researchers. They note that a number of new PDC uses are cropping up in industry, significantly improving operations. A special report describing PDC technology in more detail has appeared in the February issue of Battelle Today, in which several emerging uses of the technology are detailed, including the "smart dog tag Battelle is developing for the U.S. Army."

## No Soil in the Oil

If you're concerned about soil in your oil, take heart. A British inventor has come up with a very simple device that is said to extend the life of engine oil considerably and to decrease engine wear and operating costs. In fact, it is so simple it belongs in the "Why didn't I think of that?" department.

Marketed as the Selsdon oil filter, it consists of an insert designed to achieve added by-pass filtration. The resultant improvement in overall filtration efficiency is said to lead directly to longer oil life, less-frequent oil changes and reduced operating costs. Indirectly, it is claimed to result in less engine wear and, therefore, longer engine life, less maintenance and improved oil consumption.

The filter actually consists of a short, simple insert that fits into the existing oil filter of a vehicle, reducing its length accordingly. In operation, the insert cleans the by-pass oil immediately before it reaches the full-flow filter, thus trapping any possible media migrating from the by-pass. A conventional standard by-pass filter passes any migrating contaminants to the sump. As well, this filter insert absorbs water, which reduces the formation of acids and water/oil emulsions, adding additional protection. In field tests, both diesel and gas-powered engines have run for several times (in one case, over 10 times) their normal servicing period without changes of oil or filters. In addition, because the oil is so clean, it results in less friction and resultant fuel savings and longer engine life. There could be an opportunity here for companies interested in exploring production under license. Enquiries can be forwarded to: Mr. L. D. Seldon, SLS & C0., 41 Cumberland Court, Great Cumberland Place, London W1H 7DQ, England. ■

# Capacitor Tester

## Check out those spare capacitors with this low cost instrument.

T.R. de VAUX-BALBIRNIE


Capacitors are very common components and appear in most electronic circuits. The value is usually marked on the body with either a type of colour code or expressed in alphanumeric form, for example, 223K — the value of this capacitor is explained at the end of the article. The markings are not always clear, however, and to make matters worse different manufacturers appear to use their own variations in expressing the value.

Since a multitester cannot be used to check capacitors, there is a need for an amateur instrument which can perform this function. Such meters that are available are usually expensive. The Capacitor Tester described here is less accurate than these but is more than adequate for amateur electronics work and may be constructed for a fraction of the cost.

The device operates from a small internal battery and, in occasional use, the life of this will be very long. The standby current requirement is 15mA approximately.

### Operation

In use, the capacitor under test is connected to a pair of terminals (TB1 and TB2) on the side of the instrument. The unit is switched on and the range selected by means of a rotary switch. One of a row of green LEDs lights to indicate the chosen range.

A "push-to-test" button is now operated and a red LED flashes at the rate of about three per second, then goes off. This flash rate may be adjusted, within limits, to suit the user.

The number of flashes gives the value of the capacitor taking account of the range. Thus, with the range switch set to "10n", five flashes will indicate a value of 50nF. The ranges provided by the prototype unit are: 10nF; 1uF; 100uF; and 1000uF. When the value of a capacitor is completely unknown, the range is quickly found by trial and error.

### Circuit Description

The complete circuit diagram for the Capacitor Tester is shown in Fig. 1. IC1 is a CMOS operational amplifier and, as such, has an exceptionally high input resistance — one million megohms approximately. The importance of this point will be explained later. The capacitor under test (C1) is connected to the input terminals TB1 and TB2. The purpose of capacitor C2 will also be explained later.

Assume that switch S2 (TEST) is in its relaxed (unpressed) state and that

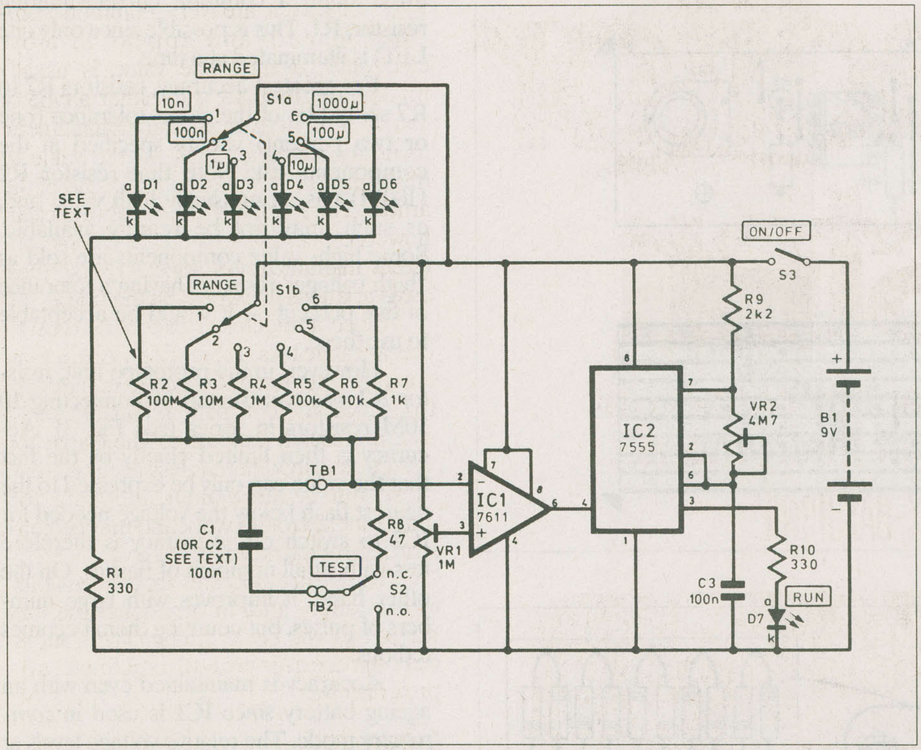



*Fig. 1. Circuit diagram of the Capacitor Tester.*

switch S3 (ON-OFF) is on. If capacitor C1 is charged for any reason, for example from a previous test, it will rapidly discharge through the normally-closed (n.c.) contacts of switch S2 and series resistor, R8. Resistor R8 is included to prevent large discharge currents which could damage S2 contacts especially where large-value capacitors were involved.

If switch S2 is now pressed (test position) capacitor C1 charges from the supply through one of the range resistors R2 to R7, as determined by the setting of rotary switch S1b (RANGE), and S2 normally open (n.o.) contacts. The voltage across capacitor C1 therefore rises from zero towards the battery voltage. IC1 *inverting* input pin two, receives this voltage. Meanwhile, IC1 *non-inverting* input, pin three, receives a fixed voltage whose value is determined by the setting of preset potentiometer VR1 connected across the supply. While the voltage applied to the inverting input remains lower than applied to the non-inverting one, the op-amp will be on with its output, pin six, high (positive supply voltage). This will be the case when S2 is first pressed.

## Astable

As the voltage across capacitor C1, hence at IC1 pin two rises, a time will come when the voltage at the non- inverting input is exceeded and IC1 switches off with pin six going low (negative supply voltage). The high or low voltage state of IC1 pin six is applied directly to IC2 reset input, pin four. IC2 and associated components are connected as an astable multivibrator and, while pin four is high this delivers squarewave pulses at its output (pin 3).

The rate at which pulses are produced is determined by R9, VR2 and C3. With the values specified this will be approximately three per second and adjustable within limits using preset VR2. Thus the LED connected to IC2 output, pin three, via current- limiting resistor, R10, will flash at this rate. When pin four is low, IC2 is inhibited and produces no pulses.

At the start of the test, LED D7 will flash but after a time dependent on the values of C1, R2 to R7 and VR1 the flashes will stop. With presets VR1 and VR2 correctly adjusted at the end of construction and with the values of R2 to R7 being accurately known (since they are close-tolerance components) the number of flashes is determined by C1 alone.

The capacitor C2 is a close-tolerance type which provides an accurately known reference value. This is connected to the terminals to enable accurate setting of potentiometer VR1 at the end of construction.

# PARTS LIST

## Resistors

R1,R10 .................................... 330
R2,R3 .................... 10M (see text)
R4 .............................................1M
R5 ........................................ 100k
R6 .......................................... 10k
R7 ............................................ 1k
R8 ............................................ 47
R9 .......................................... 2k2
All 0.25W 1%, except R1, R8 and R10 may be 0.25W 5%

## Potentiometers

VR1..... 1M sub-min. vertical trim
VR2 4M7 sub-min. horizontal trim

## Capacitors

C2,C3 ............................... 100n 5%

## Semiconductors

D1 to D6 ............5mm green LED
D7 ............................5mm red LED
IC1 ........ICL7611 CMOS op amp.
IC2..... ICM7555 CMOS 555 timer

## Miscellaneous

S1 2-pole 6-way rotary switch
S2 Push-button switch with single-pole change-over contacts
S3 SPST toggle switch

Stripboard, 0.1in. matrix size 30 holes x 9 strips; 8-pin DIP sockets; B1, 9V battery and connector; TB1, TB2 terminal posts (black and red); plastic box+; wire; stranded connecting wire; self-adhesive plastic feet; solder, etc.

With switch S2 in its relaxed state, IC1 pin two is kept high through R2-R7 so the op.-amp will be off. This inhibits IC2 and D7 does not flash. The instant S2 is pressed, IC1 pin two goes low and flashes are delivered in the manner already described.

## Range Indication

Switch S1 is a two-pole six-position rotary switch. S1b selects the range resistor as mentioned earlier. S1a operates one of six LEDs, D1 to D6 confirming the selected range – these could be omitted and the range marked around S1 control knob is desired. However, in such a case it would be wise to use an LED indicator to remind the user that the unit was switched on.

For the small cost involved, the green LEDs seemed worthwhile and were included in the prototype unit. Note that

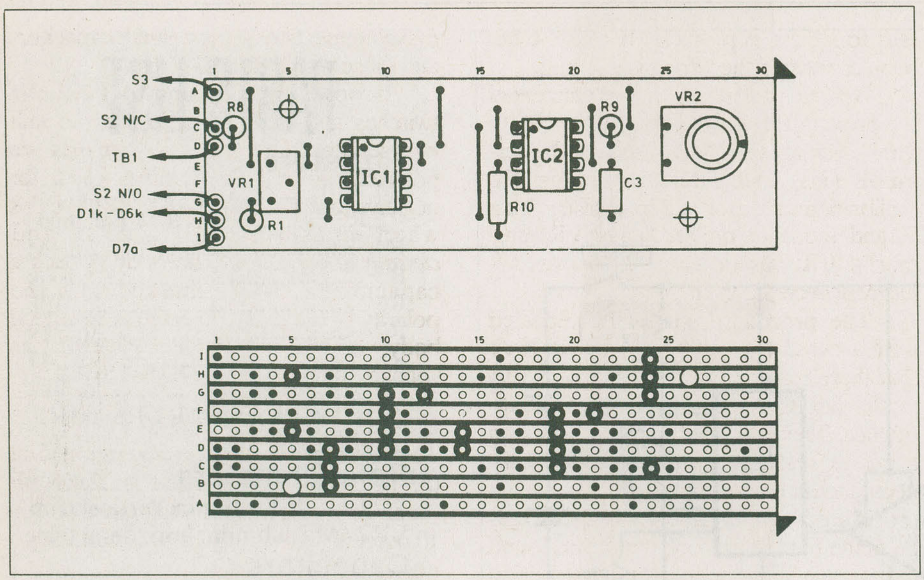



*Fig. 2. Veroboard construction.*

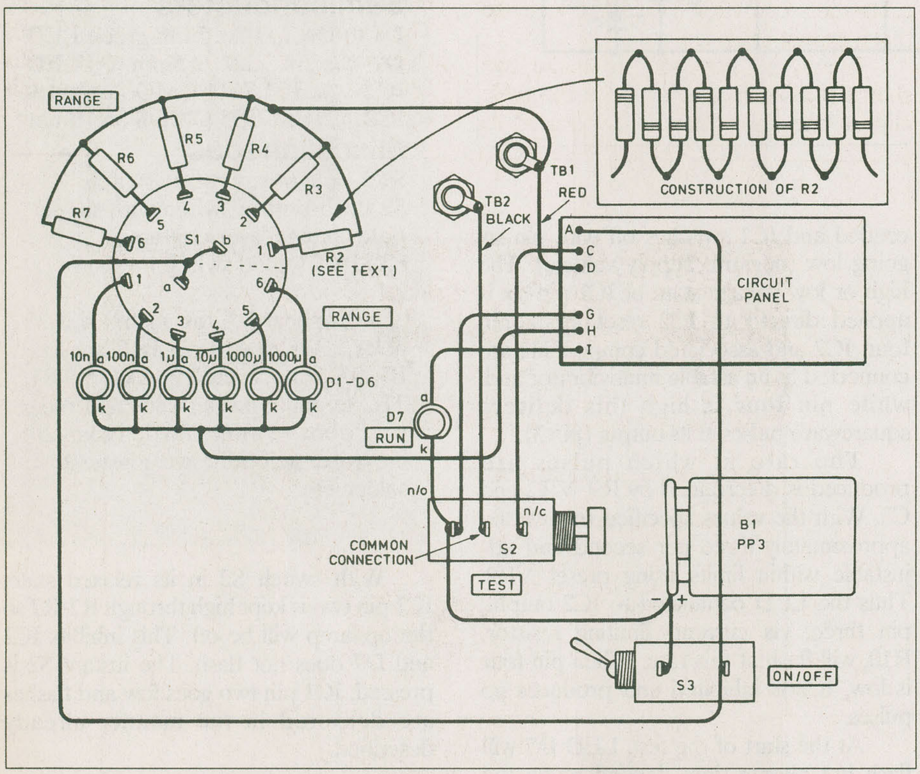
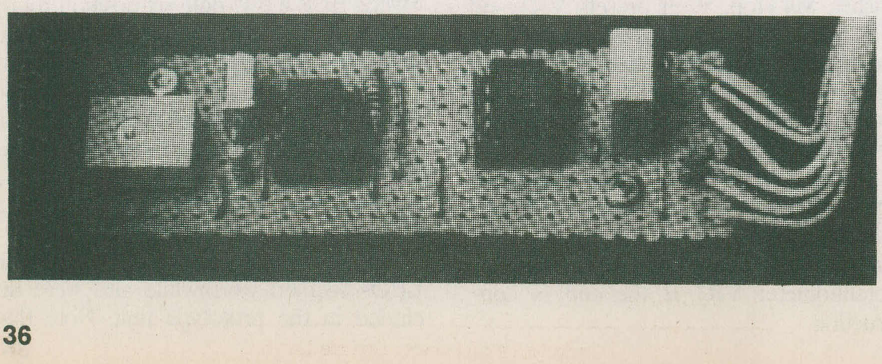



*Fig. 3. Control Interwiring*



these share a common current-limiting resistor, R1. This is possible since only one LED is illuminated at a time.

For greatest accuracy, resistors R2 to R7 should be of the close- tolerance (one or two percent) variety specified in the components list. Note that resistor R2 (100M) has an unusually high value and, as such, may not be readily available. Some high- value components are sold as "high voltage" resistors having a tolerance of five percent – it would be acceptable to use these.

However, in the prototype unit, resistor R2 was constructed by connecting 10 10M resistors in series (see Fig. 3). Accuracy is then limited chiefly by the fact that the value can only be expressed to the nearest flash below the voltage needed for IC2 to switch off. Accuracy is therefore less with small numbers of flashes. On the other hand, it improves with large numbers of pulses, but counting them becomes tedious.

Accuracy is maintained even with an ageing battery since IC1 is used in *comparator* mode. The relative voltage levels at pins two and three do not depend on the battery voltage so will always occur at the same time. Eventually, however, the battery will reach such a poor state of charge that it will fail to operate the LEDs effectively and it will be obvious when battery replacement is due.

The high input resistance of IC1 is important since, otherwise, appreciable current would flow into the IC with less current available to charge the capacitor under test. This would lead to considerable inaccuracy especially with small value capacitors.

## Construction

Construction is based on a main circuit panel made from 0.1 in. matrix stripboard size 30 holes x 9 strips. The component layout and underside details are shown in Fig. 2. Cut this to size, drill the two fixing holes and make all track breaks and inter-strip links as indicated.

Solder all on-board components into position but do not insert the ICs in their holders until the end of construction. Note that C2 (calibration capacitor) is not soldered into the circuit – it is not used until the end of construction.

After a careful check for errors – particularly for accidental "bridging" of adjacent copper tracks, solder 15cm pieces of light-duty stranded connecting wire to strips A,C,D,G,H and I along the left-hand side of the panel. Use of rainbow

ribbon cable here will keep the wiring neat and prevent errors. Set VR1 and VR2 sliding contacts to approximately mid-track position.

Prepare "resistor" R2 (100m) by connecting 10 off 10M resistors in series (see Fig. 3) unless a single component of this value is available. Solder R2 to R7 to rotary switch S1 contacts as indicated in Fig. 3.

Drill holes in the lid of the case for the switches and LEDs. Drill two holes in one of the case sides, for the terminals TB1 and TB2, and in the base for the circuit board. Attach all remaining components and complete the internal wiring paying attention to the polarities of all LEDs. The LEDs should be a tight push fit in the holes and secured, if necessary, with a dab of quick-setting epoxy resin adhesive.

Again, it is a good idea to use ribbon cable between switch S1 connections and the green LEDs. Note the link wire between S1a and S1b moving contacts and the common (k) connection at D1 to D6.

When wiring the terminals, note that TB1 is colored RED and connected to strip D on the circuit board. TB2 is BLACK and connected to switch S2 moving contact.

Remove the ICs from their special protective packing and, without touching the pins, insert them into their sockets with the correct orientation. Care must be taken in handling the ICs since they are CMOS devices and can be damages by static charge which may exist on the body.

Attach the circuit board to the base of the box using the holes drilled for the purpose, small fixings and short stand-off insulators. Connect the battery and secure it to the base of the unit using an adhesive fixing pad. Fit a control knob to switch S1 and self-adhesive plastic feet to the base of the case to prevent scratching of the work surface by the protruding bolt heads.

## Testing and Calibration

For the initial test, bridge the terminals TB1 and TB2 with a short piece of connecting wire. Check operation of the green (RANGE) LEDs, D1 to D6, by switching on S3 and rotating switch S1 through all its positions. Each LED should light in the correct sequence with D7 remaining off.

Press S2 and, keeping it pressed, check that D7 flashes. Adjust preset VR2 to obtain three flashes per second (clockwise adjustment increase the number). It is possible to choose a slightly different rate to suit the user. Note that if any LED fails to light it is probably because it has been connected the wrong way round.

Now transfer attention to adjustment of the preset VR1. Set the range switch S1 to "10n". Remove the wire bridging the terminals (TB1 and TB2) and connect the "calibration capacitor" C2 in its place. Press S2 and, keeping it pressed, adjust VR1 until exactly 10 flashes are given – clockwise adjustment decrease the number.

The procedure should be repeated until a consistent result is obtained. Note that there may be some slight eccentricity in the last flash – this is of no consequence. The instrument should now give accurate results for any capacitor connected to the test terminals.

An occasional calibration check may be made but the prototype unit was found to maintain its accuracy over a long period of time. It would be wise to tape the calibration capacitor inside the case so that it cannot become lost.

It may be necessary to make two short test leads each with a small crocodile clip at one end. These will be used to make connections to very small capacitors and those with rigid end wires.

It now only remains to label the switches and LEDs and to put the unit into service. Note that the terminals are polarized – red for positive, black for negative and it is important to observe this when measuring the value of and *electrolytic* capacitor. The body of such a capacitor is clearly marked with the polarity – the end connected to the metal body – being the negative. Note that its voltage rating should not be *less* than 9V.

## Capacitor Value

The value of the capacitor mentioned at the beginning of the article is 22,000 pF (22nF or 0.022uF) with a tolerance of +/-10 percent. This is arrived at in the following way.

The first two digits give the first two numbers of the value – in this case, 22. The third digit gives the number of zeros to express the value in picofarads. Suffix letter K means that the tolerance of this capacitor is +/-10 percent. ■

FEATURE

# Techie's Guide to C Programming Part 8

**The behind the scenes working of your C compiler can be interesting and ultimately useful in understanding how C operates.**

STEVE RIMMER

In discussions of how various things work in C, you will occasionally glimpse what's going on behind the scenes. Detractors of C have described it as being little more than a glorified assembler, and in a sense this is true. C allows you to work just a few layers above the actual machine level of your programming environment. This is, in fact, one of its main strengths... it gives you access to almost the same level of your hardware that assembly language does, without necessitating that you write every byte of code explicitly.

It's quite possible to work in C and never really know how it does things, but to do so is to deny yourself understanding of a very powerful aspect of the language. Knowing how things are passed, how C uses its stack and memory and so on will make you more able to bend it to your needs.

It's important to keep in mind that once you have compiled a C program, the resulting EXE file is just a big machine language program and, as such, C doesn't do anything magical or beyond the scope of what you *could* write in assembly language. C just lets you do it more conveniently and... hopefully... in a more structured and organized way.

This month we're going to peek behind the lexical fiction of C to understand what the language is really doing when your programs run.

## Stack of Stacks

A stack is one of the fundamental structures of any computer. Early processors, such as the 6502 which drove the Apple ][+ and the eight bit Commodore machines, were crippled by their severely restricted stacks. The 8086 series of processors which drive the PC and its descendants were designed with languages in mind which use the stack extensively.

A stack is simply a chunk of memory. The 8088 always has a stack going somewhere, and this is referred to as *the* stack.

As you will realize in a while, you can create synthetic stacks within a program if you want to, and this is often a powerful programming approach once you fully understand the usefulness of stack structures. On the other hand, C allows you to make some pretty clever use of *the* stack, the processor's stack.

For our purposes, a stack really consists of a chunk of memory and pointer into that memory, which we'll call the "stack pointer". Initially, the stack pointer points to the highest location in the stack's memory. In practice, the stack is usually the highest object in memory, so the initial stack pointer points to the top of free RAM.

A stack is called a "first in last out" structure. If we "push" a number onto the stack, that number will be stored at the place where the stack pointer points, and the stack pointer will be decremented to point to the next location down the stack. Stacks always grow downward. Note that we haven't specified how big a position on the stack is yet... that will come in a moment.

Subsequent numbers which are pushed onto the stack will cause the stack pointer to be further decremented.

When we "pop" the stack, we get the last number pushed onto the stack back, and the stack pointer is incremented to point to the previously pushed number. All the numbers on the stack below the current location of the stack pointer are considered to be garbage. Once popped off the stack, a number is no longer valid.

Here's what this might look like in C. In this example, each element on the stack is an *int*.

```
#define stack_size256
int stack[stack_size]
int stack_pointer=stack_size-1;

push(i)
int i;
{
if(stack_pointer = = 0) {
puts("*** Stack overflow ***");
exit(1);
}
stack[stack_pointer--]=i;
}

pop()
{
if(stack_pointer = = stack_size) {
puts("*** Stack underflow ***");
exit(1);
}
return(stack[stack_pointer+ +]);
}
```

This is actually a bit simplistic... the stack pointer isn't even a pointer, but rather and index into an array of stack elements... but it illustrates two of the common problems with stacks. If the stack is pushed too often it will exceed the space allocated for it and trample on something else... most often your program... creating what is called a "stack overflow" condition. If it's popped too often it will "underflow", and the stack pointer will back up over whatever is above the stack.

In the case of the PC, the top of the stack usually resides at the top of a segment, so a stack underflow condition will usually trample something lower down in memory. Don't worry if you don't see why that is just yet.

Accessing the real processor's stack is handled by special machine language instructions, of course. You do not manipulate it directly from C.

The stack is used for a number of purposes. The most basic of these handles the calling and returning from of subroutines or, in C terminology, functions. Consider this simple program.

```
main()
{
print("Steal your face");
}

print(s)
char *s;
{
while(putch(*s+ +));
}
```

When *main* calls the function *print*... and, indeed, when *print* calls *putch*, a library function... the processor executes a machine language CALL instruction to where the actual machine language code which will do what *print* says to do is stored in memory. The mechanism of the CALL instruction is as follows.

First off, it takes the address of the next instruction after the CALL and pushes its onto the stack. Next it takes the address of that which is to be called and puts it in the IP register of the processor. The IP register... the instruction pointer... tells the processor where the next thing it's to do is located in memory. Then it returns control to the processor, which executes the code for the function. The "return address", the place where *main* is to resume after the call to *print*, is now stored on the stack.

The last thing in the code for *print* is a machine language RET, or return, instruction. Under C, a RET is implicitly placed at the end of every function by the compiler. The action of a machine language RET is to pop the most recent number off the stack... hopefully the return address we spoke of a moment ago... and put it in the IP register of the processor. As such, the processor returns to the next instruction after the CALL.

The second use of the stack is to store numbers. Consider this bit of code. In this function, we have a variable, *a*, which for reasons not adequately explained herein we want to use for two things in the course of the function.

```
my_function(n)
int n;
{
int a;

a = n * n;
push(a);

if(a = = 0) {
for(a=0;a;+ +a) puts("A equals zero!!!");
}

a=pop();
return(a);
}
```

Delightfully pointless, this function will return the square of its argument, and it will print out a warning ten times if its argument is zero. There are lots of better ways to do this even if you could think up a reason why you'd want to do it at all. The important thing, here, is that we've used our *push*. and *pop* functions to temporarily save *a* on our make- believe stack and then restore it.

This is a use of the stack which is seen frequently in machine language, because the processor has a limited number of registers, its equivalent of variables. If a program wants to save the contents of one for a while and then get it back, it will usually do so by pushing it onto the stack and popping it off later.

Here's the third use of the stack. This one is important. If you execute this bit of code...

```
my_function(12);
```

... have you ever wondered exactly what happens to the number twelve? Ob-

viously, it has to go somewhere. In fact, the process for passing arguments to functions under C is brilliantly flexible, but so weird you'd wonder how anyone ever thought it up.

When our program calls *my_function*, the first thing it actually does is to push twelve up onto the processor's stack. Then it calls the code which actually makes *my_function* go. Finally, it pops twelve off the stack and throws it away.

In between all this, *my_function* accesses the twelve on the stack by taking the current stack pointer and peeking back up the stack to find out what was pushed up there prior to the numbers which represent the return address of the function. This is a bit of dance, to be sure. One of the complexities of C is that each function has to know what sort of arguments to expect because it has to know how to peek back up the stack. This is why when we write a function with arguments, we must declare what each argument's type is.

The final use of the stack under C is as a place to store local variables. If we write a function like this...

```
dog_breath()
{
int i;

for(i=0;i;++i) puts("Dogbreath");
}
```

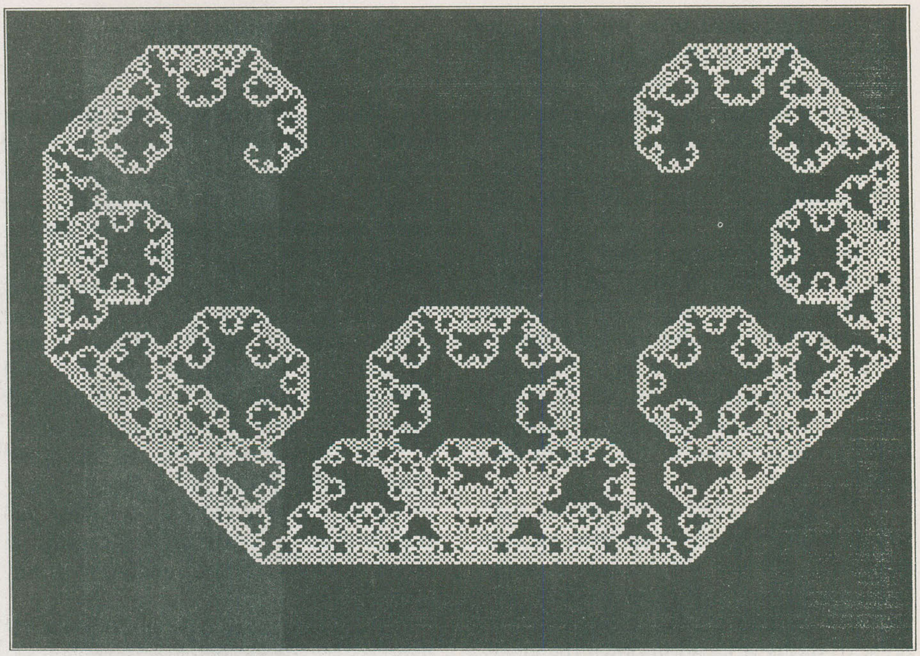
upon execution, the function will allocate some variable space for *i*. It does so by subtracting one from the current stack pointer, thus creating a gap in the stack. This gap will be used to hold the value of *i* for the duration of the function. When the function is complete, it will add one to the current stack pointer, thus closing up the gap, throwing away whatever was in *i* and restoring the stack to what it was, all ready to have the return address popped off it.

In this way, space for variables is allocated only for as long as they're needed.

The astute reader will note that variables passed as arguments to a function exist as numbers on the stack and variables created by the function itself also exists as numbers on the stack. This is why C is able to treat them the same way. Handy, isn't it...

## Real Stacking

The stack of an 8088 is sixteen bits wide. This means that every time a program pushes a number onto it, one sixteen bit *int* is stored. The stack pointer moves by two bytes. You cannot push an eight bit... one



byte... number onto the processor's stack... rather, you must save it in part of a sixteen bit number and push this.

Larger objects, such as thirty-two bit *long* numbers or sixty-four bit floating point values are pushed onto the stack sixteen bits at a time, so that if you pass a *long* value to a function, two things actually get pushed onto the stack.

Knowing this, we can optimize our programs a bit. For example, there is no space saving in declaring a single *char* value rather than a single *int*, because any variable allocated from within a function... excluding static variables, which we won't talk about now... must have its space allocated on the stack, and that space comes in *int* size chunks. Likewise, there's no saving in writing a function which accepts *char* values over *ints* as arguments, nor one which returns them.

Let's look a bit further into this. This allocation takes up one sixteen bit position on the stack, as we've seen.

```
int a;
```

What about this one?

```
int *a;
```

In this second case, *a* is a pointer to an *int*. The question, then is, how much space a pointer takes up. The answer... depends.

On the PC, a location in memory is pointed to by two numbers. The first one is called the "offset". This tells us the local position of the number. In fact, it's relative to the current "segment" value, which is the second of the two numbers.

The memory in a PC is "segmented". This is a bit nasty. It happened for the following reason... more or less. When the 8088 chip which drove the first PC was designed, the trolls in marketing thought that it would be nice if it could access a megabyte of memory, which, in those days seemed like an awful lot. Unfortunately... said the engineers... the chip only had sixteen bit registers, which even a troll from marketing could see would only access sixty-four kilobytes. Actually, the trolls from marketing couldn't see this, 'coz they didn't know a register from an RRSP.

The engineers came up with a solution to this. They combined two sixteen bit registers to form one bigger twenty bit register. Yes, I know... when I went to school a couple of sixteens was good for thirty-two as well, but they only needed twenty bits to address all that memory. However, just to get back at those marketing suits, they used the upper bits in a sort of weird way. They divided a megabyte by sixty-four kilobytes and called the resulting number... sixteen... a segment. The upper part of the number, then, would be the number of sixteen byte segments in the address, and the lower part of the number would be the address in the current segment. A segment encompasses the sixty-four kilobytes directly above it.

A pointer under C, then, can be of several types. If the program and all its data will fit in a single sixty-four kilobyte segment, we can use what is called a "small model" for the program and all the

pointers will be sixteen bits wide... one place on the stack. If the program will fit in one segment but the data for the program will not, then we must use the "medium model", which means that the pointers must be thirty-two bits wide, although all the calls to functions can be done with sixteen bits, which saves one place on the stack for each call. This can be handled the other way around under some C compilers... sixteen bit pointers and thirty-two bit calls for big programs with small amounts of data.

Under the large memory model, both pointers and function calls are handled as thirty-two bit numbers. Most programming is done under this memory model. There is another memory model, the "huge" model, which we'll speak of at another time.

The advantage of the small model is that its programs take up less space and run faster. The advantage of the large model is that its programs and their resulting data can be bigger than a single segment.

The great thing about C is that you can change memory models... in most cases... by just telling your compiler that you want to. In the case of Turbo C, it's a single menu option. Change from the small model to the large model and on the next compile everything will be adjusted for you. You never have to worry about how much space to allow on the stack and so on.

## Flapjacks

If you understand the fundamentals of stack manipulation under C, you will be a lot closer to understanding how the language works. You will also understand how to avoid a lot of the potential problems which C programs are heir to, because a lot of them involve misuses of the underlying stack structure of C.

In addition, as you get a bit more advanced in C, you'll learn how to optimize your programs by thinking about how the code you write interacts with the real time world of the processor that, ultimately, makes everything go.

To finish our discussion of the C language stack off with something interesting, you might want to check out the following little program. This is written in Turbo C, and uses the Turbo graphics library. Other compilers might require a few trivial changes to the code to make it compile. It generates the accompanying picture when it runs, and you can change the default parameters by giving the program command line arguments to see how the picture changes.

The important part about this program, though... aside form the fact that it creates pretty pictures... is how it uses its stack. Recalling that we said that calling a function causes its return address to be pushed up onto the stack... not to mention its local variables allocated there... what would you think would happen in a program where a function repeatedly calls itself? This is what happens in this program.

To make this go, type the source code into a file called curve.c. Create a second file called curve.prj, and type the following two lines into it.

```
curve
graphics.lib
```

Set the Turbo C project to CURVE.PRJ and compile the program. If all goes well, you'll see a text message and, upon hitting a key, the curve will start to form on your screen.

When you get tired of playing with the curves, you might go back to figuring out how this program is using the stack.

```
/*
C Curve generator
copyright (c) 1988,1989 Alchemy Mindworks Inc.
*/

#include "stdio.h"
#include "graphics.h"
#include "math.h"
#include "conio.h"

#defineTHETA45

double SINTH,COSTH;
double prm[5] = { 250,50,400,50,2 };

main(argc,argv)
int argc;
char *argv[];
{
int d,m,e=0;

cprintf("C curve generator copyright (c)"
"1988, 1989 Alchemy Mindworks Inc.\n");
if(argc1) for(d=1;dargc;++d) prm[e++] = atof(argv[d]);
cprintf("Parameters are %g %g %g %g RESOLUTION %g\n",
    prm[0],prm[1],prm[2],prm[3],prm[4]
);
cprintf("Hit any key...");
if(getch() == 27) exit(0);
init();

COSTH=cos(THETA*M_PI/180);
SINTH=sin(THETA*M_PI/180);

curve(prm[0],prm[1],prm[2],prm[3]);
getch();
deinit();
}

curve(x1,y1,x2,y2)/* draw one curve */
double x1,x2,y1,y2;
{
double xd,yd;
double mx,my;
double xdr,ydr;

xd=x2-x1;
yd=y2-y1;
if(((xd*xd)+(yd*yd))
(prm[4]*prm[4]) || kbhit())
    line((int)x1,(int)y1,(int)x2,(int)y2);
else {
xdr=xd/2/COSTH;
ydr=yd/2/COSTH;
mx = x1+xdr*COSTH-ydr*SINTH;
my = y1+xdr*SINTH+ydr*COSTH;
curve(x1,y1,mx,my);/* it calls.... */
curve(mx,my,x2,y2);/* ... itself!!! */
}
}

init()/* get into graphics mode */
{
int d,m,e=0;

detectgraph(&d,&m);
if(d) {
puts("No graphics card");
exit(1);
}
printf("d=%d\n",d);
initgraph(&d,&m,"");
e=graphresult();
    if(e) {
printf("Graphics error %d: %s",
    e,grapherrormsg(e));
exit(1);
}
setcolor(getmaxcolor());
}

deinit()/* get out of graphics mode */
{
closegraph();
}
```

FEATURE

# AutoCAD for Electronics Part 4

**Some tips, techniques and reviews of helpful books.**

BILL MARKWICK

Last month we began drawing a schematic using some of the macro tricks explained in the article on custom menus. This month we look at manipulating your drawing in quick, efficient ways using variations on the standard AutoCAD commands. Sometimes speed in drawing and regeneration is obtained by nothing more than using one command instead of another.

### Attributes

When we last looked at Attributes, we pointed out that they can save you a great deal of time when dealing with standard blocks from your library of electronic components. You can insert a resistor, for instance, and AutoCAD will prompt you for its number and value; these are placed automatically when you type them in.

It certainly beats endless jiggling with the Text and Move commands. If you want to change anything afterwards, the ATTEDIT command lets you change any or all attributes with only minor headaches due to the awkward syntax. One of the frequent difficulties with Attribute Editing is that AutoCAD asks you to select an attribute and then says "Invalid" because it din't recognize your choice, no matter how carefully you Pick the object. Try using a window to select the attribute; this seems to work more reliably.

Adding another attribute to a block can get confusing. ATTEDIT will only let you change existing ones, and redefining a block within a drawing is fraught with difficulty – in fact, most of the time AutoCAD won't let you redefine the block because it references itself. One way out of this is to rename the changed block; AutoCAD will accept that. If your blocks are drawn from a disk library, editing the block as an Existing Drawing is another, slower way to do it. However, keep in mind that Blocks are always stored with your drawing once they're loaded, and editing a library block will not change blocks of the same name in your drawing. In fact, you can't even load in your newly edited version unless you rename it.

If your attributes slow down regeneration too much (as most text does), use the ATTDISP command to shut them off until you need them. You can also specify an atttribute as Invisible when you create it; this automatically shuts it off until it's restored by ATTDISP.

No doubt you've read about Attribute Extraction; the attribute list can be written to a file for use by a word processor, spreadsheet or database. This is a very useful feature for people who use AutoCAD a lot to make large drawings and need to keep track of parts lists, bills of material, etc. On the other hand, the syntax is so complicated that I don't feel it's worth the effort for electronics use – after all, you probably started off with a parts list anyway. I'll look into it with some industry AutoCAD users; if there's enough interest, we'll present some uses of the extraction files in a future issue. In the meantime, it's one-tenth the work to process the lists manually rather than learn AutoCAD template files.

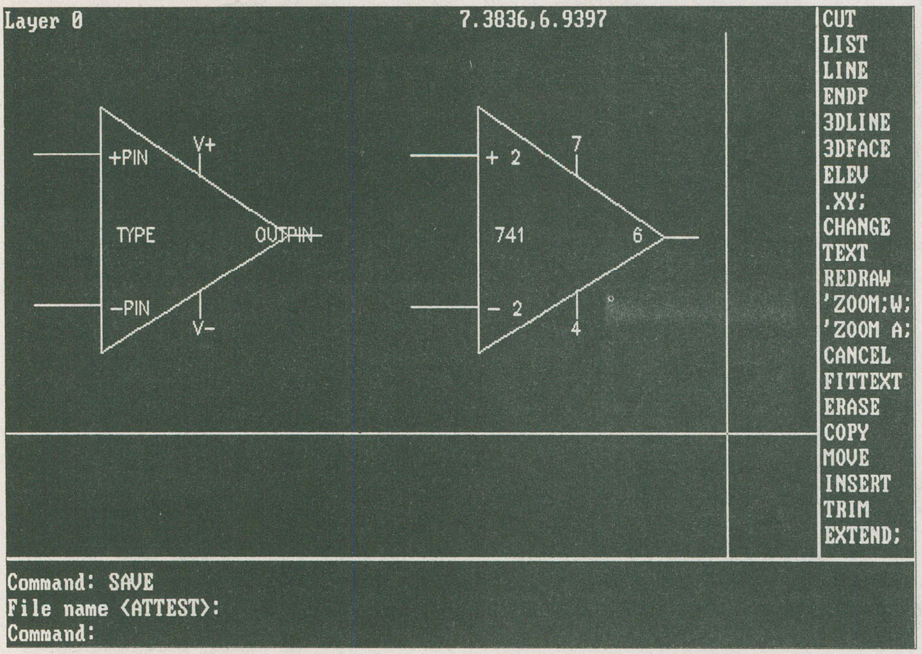



*Fig. 1. Using attributes to speed up text entry. On the left is the master drawing of an amp; the labels are the Attribute Tags. On the left is what the amp would look like Inserted into a drawing; AutoCAD prompts you for the pin numbers.*

## Memory Management

By and large, AutoCAD has automatic memory management, which is a good thing, because the subject is sketchily covered both in the manual and the Installation and Performance Guide. It's unlikely you'll have to tinker with memory much (I've assumed that you have a 640K computer).

**Extended Memory** is memory above the 640K limit on ATs and compatibles (80286 machines). With most machines, you can add 384K for a total of one megabyte. AutoCAD will automatically use whatever extended memory is available as I/O page space to reduce disk accesses, even if you have RAM disks or caches in use in the extended-memory area.

**Expanded Memory** or EMS is whole bunches of memory added via expansion cards (or motherboard sockets on some machines); it conforms to the Lotus-Intel-Microsoft specification for memory expansion and is often called LIMs. AutoCAD works with this, too.

**ACADFREERAM** is a working storage area in AutoCAD, set from 5K to 20K using the SET command in your Autoexec.Bat file. If you get out-of-memory error messages, particularly with the RAM-hog SKETCH command, try setting this to a higher value.

**LISPHEAP and LISPSTACK** are exotic bits of memory-handling for the AutoLISP programming language, and since this is the subject of a future issue, I won't cover it in any detail. However, here's the part of my Autoexec.Bat file that's relevant to AutoCAD:

```
SET ACADFREERAM=20
SET LISPHEAP=20000
SET LISPSTACK=6000
```

This seems to work well, with only the occasional anguished peeping from the Sketch command because I'm drawing too fast without saving.

## Polylines

The Pline command is a great timesaver, and very flexible, too. There are three main reasons for using polylines: one, you can easily vary their width; two, anything drawn with a polyline is seen as a single entity, like a block; three, you can use Pedit (polyline edit) to draw complex curves.

**Width:** not only can you get lines of various widths, but you can have the ending width different from the beginning. This lets you make triangles and arrowheads that are easier and faster to draw than doing it with separate lines.

**Single Entities:** if you draw a closed shape with a polyline, the final segment can be automatically inserted by typing C (Close) instead of picking a point. Now your polyline can be treated as a block, easily copied, moved, erased, etc. This also applies to the arrowheads mentioned above – they move or copy without windowing or multiple object selection.

**Curves:** although the polyline's Arc function isn't as easy to use as a line Arc, the Fit and Spline functions make short work of complicated curves. To draw a sinewave, for instance, you just make a triangle wave with Pline, then select Polyline Edit (Pedit) and Spline Curve. The Fit

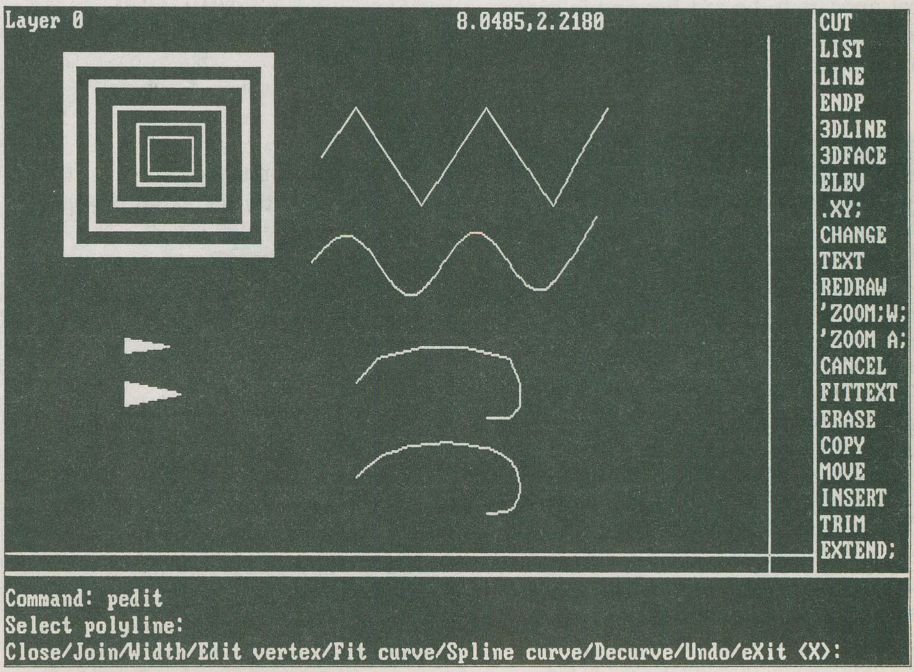



*Fig. 2. The versatile polyline: at the top left, a series of various line widths, and underneath, line widths that change from one end to the other make simple arrowheads. At the right, a triangle polyline and its conversion to a sine using Pedit.*

function can be used to join a series of polylines into various compound curves. If you don't like the result, Decurve puts you back to straight polylines.

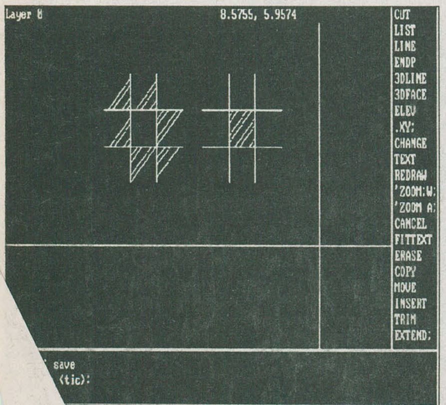
## Hatching

If you compare Hatching to any paint program's Paint command, you might decide that AutoCAD is a Bear of Very Little Brain. Your hatch pattern misses some of the corners, spills over outside the lines and gets generally cantankerous.

You can make the best of it by making sure that you're hatching inside a straightforward, closed figure with no lines sticking out into space. If, for instance, you wanted to hatch the inside square of a tic-tac-toe grid, and you just selected all four lines, you'd end up with hatching spraying everywhere (see Fig. 3). To do the hatching neatly, you need to isolate the inner square. One way to do this (if you're just starting the drawing) is to draw the inner square, hatch it, and then add the external lines. If the drawing is already done, the Break command can be used to isolate the square without actually causing visible gaps: type Break, select one of lines, type F (for First Point) and click both First and Second points on the nearest intersection. Repeat this until the inner square is free-standing.

If you have a drawing with complicated curves, it's often easier to coarsely outline the shape with a series of straight lines. Hatch inside these and then erase them.

And of course, if you need hatching that appears to be just hanging in space, draw its outline with straight lines, hatch inside these, and then erase them. ■




*3. The Hatch command can be in-
g if you don't create a neat,
d figure to guide it. On the left,
nes are simply selected and the
es all over the place. On the
ak command has been
the inner square.*

# CADBOOKS

## Working Out With AutoCAD

Martha Lubow, New Riders Publishing, Thousand Oaks, California 91360. New Riders publish quite a few excellent books on AutoCAD, and this is one of them. It's not just another rewrite of the reference manual, but a tour through a number of drawings that shows efficient ways to solve drawing problems. New Riders books are available at most major bookstores.

## CADalyst Magazine

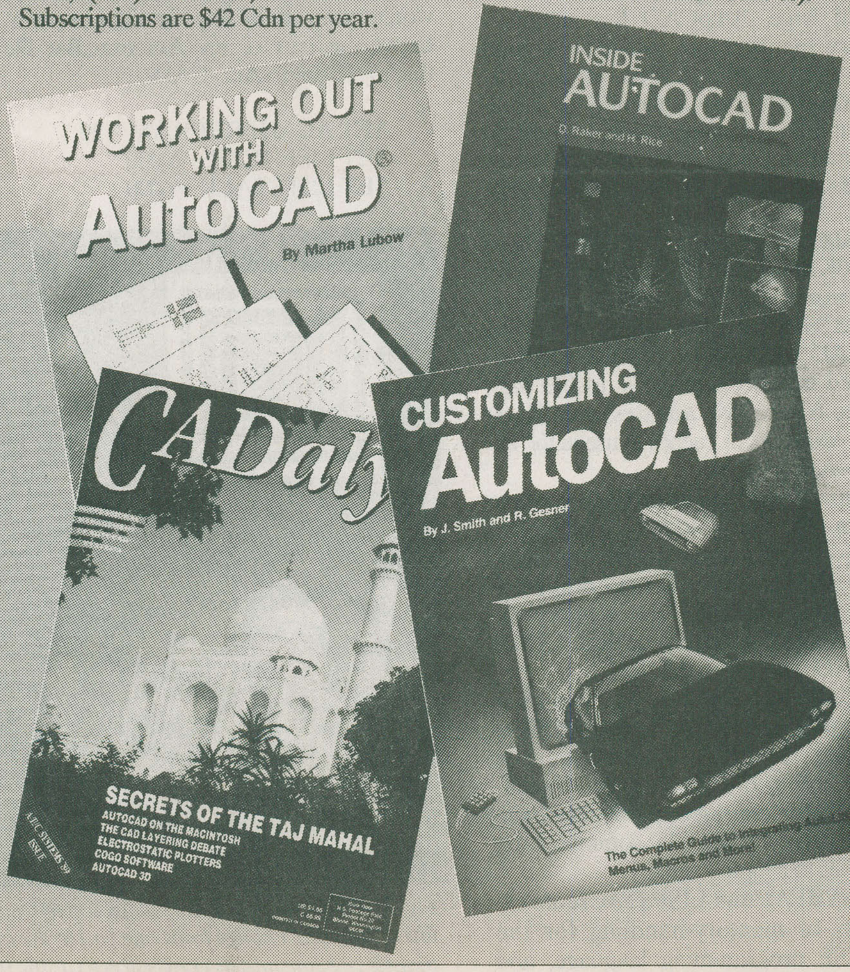
A Canadian monthly that's essential reading for anyone who works with AutoCAD, whether it's full-time or occasionally. It features hardware and software reviews (usually from several viewpoints), AutoLISP tutorials, beginner's sections, industry discussions, and more tips and techniques than you can shake a digitizer at. 202-210 W. Broadway, Vancouver, BC V5Y 3W2, (604) 873-0811, Fax 873-5888. Subscriptions are $42 Cdn per year.

## Inside AutoCAD

D. Raker and H. Rice, New Riders Publishing. A fine tutorial that clarifies many of the points in the reference manual. This one was popular for quite a while, and is now completely updated into a new edition that includes Release 10's full 3-D. Good examples of Attributes and Dimensioning.

## Customizing AutoCAD

J. Smith and R. Gesner, New Riders Publishing. This huge softcover is one of the very few books to explain the real workings of AutoCAD's custom menus, macros, AutoLISP, and much more. It's inspiring. Unfortunately it's something of a programmed course — you can't just dip in anywhere because many of the examples depend on previous work. Still, you can order a set of disks that eliminate having to type things in (and there's a lot of that if you want the best of the LISP utilities).



# NEXT MONTH IN

## Electronics & Technology Today


### Our Project Special!

It's time for our annual roundup of build-it-yourself projects, some small, some large, on a wide variety of electronic topics.

### Video Special, Part 2!

Continuing with a look at the new equipment and techniques available to give you the best performance from our rusty old NTSC system. VCRs, editors, cameras and more.

### The 1989 AES Show

The audio people haven't been idle, either. Tim Benson takes a look at new improvements in analog and digital sound equipment as discussed at the Audio Engineering Society annual meeting.

Plus, of course, the usual projects, articles and news!

## Subscribe today!

For advertising or subscriptions, please call (416) 445-5600, FAX 445-8149.

# SUBSCRIBE TODAY!

## Be sure of your issue each month


## Moorshead Publications

1300 Don Mills Road, Toronto, Ontario M3B 3M8

**SUBSCRIPTIONS:** ☐ NEW SUBSCRIPTION ☐ RENEWAL

**Electronics & Technology Today**

☐ One year (12 issues) **$22.95** ☐ **Two years (24 issues) $37.95**

**Computing Now!**

☐ One year (12 issues) **$22.95** ☐ Two years (24 issues) **$37.95**

**Computers in Education**

☐ One year (10 issues) **$25.00** ☐ Two years (20 issues) **$45.00**

**Outside Canada** (US Dollars)

For U.S. please add $3.00 per year ☐ Other countries add $5.00 per year ☐

NAME ______________________

ADDRESS ______________________

TOWN/CITY ____________ PROVINCE/STATE ____________

CODE ____________ DATE ____________

POSTAL CODE ______________________

☐ Cheque enclosed DO NOT send cash

☐ MasterCard Account No. ______________________

☐ Visa Account No. ______________________

☐ American Express Account No. ______________________

Expiry Date ______________________

Signature ______________________

To order Books, Back Issues, Binders, Software and Special Publications, see over.

# ORDER FORM

## Software

________ ________ $ ______
________ ________ $ ______
________ ________ $ ______

Sub Total $ ______
Tax (Ontario Residents) 8% $ ______
Postage $ ______
Total Enclosed $ ______

## Bookshelf

| CODE (e.g. BP12) | TITLE (Short form acceptable) | PRICE |
|---|---|---|
| | | $ |
| | | $ |
| | | $ |
| | | $ |
| | | $ |

## Special Publications

| ITEM | QUANTITY | AMOUNT |
|---|---|---|
| | | $ |
| | | $ |

## Binders

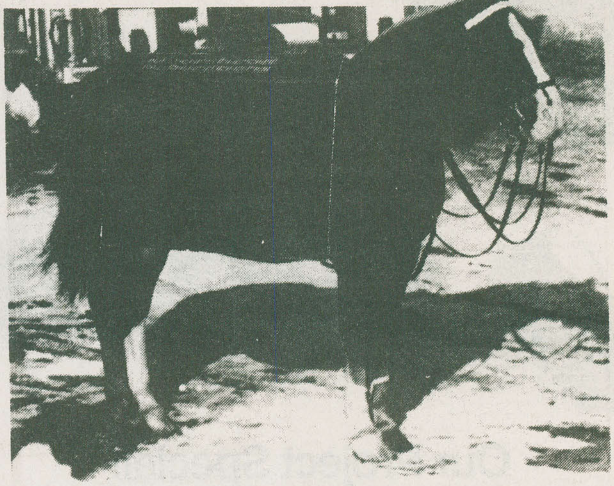
| ITEM | QUANTITY | AMOUNT |
|---|---|---|
| Moorshead Publications $9.75 each (Ontario Residents add 8% P.S.T.) | | $ |

## Back Issues

$4.00 each. Ontario residents add 8% P.S.T. Some issues may be out of stock. Please call the Reader Service Department at (416)445-5600 or enclose a self-addressed, stamped envelope for a complete list of available issues.

Orders from the Bookshelf are tax exempt.
Please add $1.00 for postage.
Ontario residents add 8% P.S.T.
for Specials and Software.

# The Electronics and Technology Today Horseblanket/ Magazine Binder



One day one of Toronto's Finest parked his horse at the firehall next door to us, making him fair game for yet another in our series of great, unforgettable, stupid binder ads.

Our binders are covered in sturdy vinyl, and use spring rods to hold a year's worth of magazines without cutting or punching, allowing them to open flat for reading or photocopying.

They're available from us for $9.75, which includes postage and handling. Ontario residents add 8% (Ouch!) provincial sales tax.

We would also like to point out that
(a) Toronto policemen generally use cars, and
(b) because the binders are magazine-sized, they work as blankets only if the horse is under 36 inches long.

Send to:

**Binders**
**Moorshead Publications**
1300 Don Mills Road, Toronto, Ontario M3B 3M8

# ORION ELECTRONICS SUPPLIES INC.

IMPORTERS & DISTRIBUTORS | INDUSTRIAL — COMMERCIAL — EDUCATIONAL | SALES & SERVICE

## ORION SYSTEM 88

4.77/10 MHZ MOTHER BOARD. 256K MEMORY
360K DISK DRIVE AND ADAPTER. MONOCHROME OR COLOUR VIDEO. ADAPTER.
SERIAL. PARALLEL. GAME. CLOCK PORT.
150W POWER SUPPLY. AT KEYBOARD.

**$599**


## ORION SYSTEM 286

6/10/12.5 MHZ MB. 512K MEMORY
1.2MB DISK DRIVE. 16 BIT DISK CONTROLL
MONOCHROME OR COLOUR VIDEO ADAPTER.
SERIAL. PARALLEL. GAME. CLOCK PORT.
200W POWER SUPPLY. AT KEYBOARD.

**$999**

## ORION SYSTEM 386

1MB MEMORY. 16/20 MHZ MOTHER BOARD.
1.2MB DISK DRIVE. 16 BIT DISK CONTROLL
MONOCHROME OR COLOUR VIDEO ADAPTER.
SERIAL. PARALLEL. GAME. CLOCK PORT.
200W POWER SUPPLY. AT KEYBOARD.

**$1999**

CALL FOR THE LOWEST CUSTOM QUOTES

## ORION PORTABLE SYSTEMS

| | 88 256K | 286 512K | 386 1MEG |
|---|---|---|---|
| 9" AMBER DUAL CRT | 1295.00 | 1895.00 | 2995.00 |
| LCD 600x400 SCRN | 1645.00 | 2245.00 | 3345.00 |
| PLASMA 600x400 S | 2395.00 | 2995.00 | 4095.00 |
| 9" EGA MONITOR | 2795.00 | 3395.00 | 4495.00 |

# HARDWARE, SOFTWARE & PERIPHERALS AT *DISCOUNT* PRICES

### SEAGATE HARD DISK SYSTEM

20MB (DRIVE CONTROLLER/CABLE) ... 399.95
30MB (DRIVE CONTROLLER/CABLE) ... 429.95
40MB ST-251 ... 499.95
WE CARRY THE MOST EXTENSIVE LINE OF REG. OR HIGH DENSITY DRIVES & CONTROLLERS. (CALL FOR A COMPLETE PRICE LIST!)

### FLOPPY DISK DRIVE

**PANASONIC OR EPSON (YOUR CHOICE)**
5¼" 360K DSDD ... 119.95
5¼" 1.2M HIGH DENSITY ... 139.95
3½" 720K DSDD ... 125.95
3½" 1.44M HIGH DENSITY ... 145.95
HARDWARE & MOUNTING BRACKET -
- FROM 3½" - 5¼" ... 9.95

### HARD DISK & FLOPPY DISK CONTROLLER

XT FLOPPY CONTROLLER ... 39.95
XT HIGH DENSITY CONTROLLER ... 74.95
XT HARD DRIVE CONTROLLER ... 85.95
XT RRL HARD DISK CONTROLLER ... 99.95
AT HARD DISK/FLOPPY CONTROLLER ... 189.95
AT RRL HARD DISK CONTROLLER ... 299.95
AT HARD DISK CONTROLLER ... 169.95

60M TAPE BACKUP SYSTEM FROM ... 895.00

### MODEMS/FAX

1200 HAYES COMP. INTERNAL ... 99.95
1200 HAYES COMP. EXTERNAL ... 129.95
2400 HAYES COMP. INTERNAL ... 189.95
2400 HAYES COMP. EXTERNAL ... 199.95
FAX CARD 4800 WITH SOFTWARE ... 649.00
FAX CARD 9600 WITH SOFTWARE ... 995.00
PANAFAX UF-150 WITH PHONE ... 1695.00
PANAFAX UF-250 WITH PHONE ... 2495.00

**SCANNERS**
HANDY SCANNER 2.5" ... 299.95
HANDY SCANNER 4 1/8" ... 375.95
LOGITECH SCANNER 4 1/8" ... 399.95
CAT IMAGE SCANNER (FOR PRINTER) ... 299.95
CHINON DESK SCANNER ... 895.95
SHAPE DESK TOP ... 1295.00

### MICE

LOGITECH SERIAL ... 99.95
LOGITECH HIREZ SERIAL ... 139.95
LOGITECH HIREZ BUS ... 149.95
DEXXA 2 BUTTON ... 69.95
DXXA DLX ... 79.95
GENIUS DLX 3 BUTTON ... 79.95
MOUSE PAD ... FROM ... 7.95
IBM COMPATIBLES JOY STICKS ... FROM ... 29.95
GRAVIS CANADIAN MADE JOYSTICK ... 54.95

**DIGITIZERS**
KEMAN CT1170 1000 LINE/INCH ... 495.00
TITAN KT2000 400 LINE/INCH ... 550.00
TITAN KT3000 1000 LINE/INCH ... 595.00

**POWER SUPPLIES**
150W UL/CSA ... 99.95
200W UL/CSA ... 139.95
200W UL/CSA FOR TOWER CASE ... 189.95
AT STYLE CASE FLIP UP FOR -
- XT OR BABY AT MOTHER BOARD ... 69.95
AT FULL SIZE CASE WITH HARDWARE ... 109.95
AT TOWER CASE ... 225.95

PORTABLE FOR AT OR XT WITH POWER SUPPLY -
- 9" DUAL AMBER MONITOR, KEYBOARD ... 895.00
LCD PORTABLE WITH POWER SUPPLY KEYBOARD -
- 600x400 LCD SCREEN ... 1150.00
SAME AS ABOVE BUT PLASMA DISPLAY ... 1795.00

**KEYBOARDS**
XT/AT 5060 STANDARD 8 KEY KEYBOARD ... 69.95
XT/AT ENHENCED 101 KEY KEYBOARD ... 89.95

### IBM COMPATIBLE BOARD

**MOTHER BOARD**
4.7 / 10MEG XT OK ... 129.95
6/8/12 MEG AT 286 OK ... 375.00
10/12 MEG. AT 286 4MEG EMS OK ... 399.00
16/20 286 "NEAT" ... 895.00
16/20 386 OK ... 1250.00

**VIDEO ADAPTER**
MGA HERCULES COMP. W/ PRINTER PORT ... 69.95
CGA COLOR GRAPHIC VIDEO ADAPTER ... 59.95
EGA 640x350 256K ... 229.00
SUPER EGA 640x480 256K ... 275.00
ATI GRAPHIC SOLUTION ... 119.00
ATI WONDER CARD ... 299.00
ATI VIP MGA/CGA/EGA/VGA ... 459.00
ATI WONDER + VGA AUTO ... 549.95
G7 MGA/CGA AUTO SWITCH ... 89.95

**I/O CARDS**
XT PARALLEL PRINTER PORT ... 29.95
XT RS232 SERIAL PORT ... 34.95
XT I/O + 2 (S/P/C/G) ... 79.95
XT MULTI I/O (S/P/C/G/DISK CONTR) ... 89.95
XT GAME PORT (TWO PORT) ... 29.95
AT GAME PORT ... 49.95
TIME CARD WITH BATTERY BACK UP ... 49.95
AT I/O SERIAL/PARALLEL ... 69.95
AT I/O SERIAL/PARALLEL/GAME ... 79.95

**MEMORY CARDS**
XT 576 RAM CARD OK ... 54.95
XT 2 MEG EMS 3.1 3.2 4 OK ... 129.00
AT 2 MEG EMS .OK ... 149.00
2.5 MEG EXPANSION CARD ... 109.00

### APPLE COMPATIBLE COMPUTER

**BOARDS**
III LASER 128EX II + /IIe/IIc COMP ... 649.00
LASER DISK DRIVE "C" COMPATIBLE ... 199.95
LASER DISK DRIVE II + COMPATIBLE ... 199.95
80 COLUMN CARD AUTO SWITCH ... 99.95
Z80 CARD FOR CPM ... 69.95
SERIAL PRINTER CARD MODEM/ PRINTER ... 99.95
NICE PARALLEL PRINTER CARD ... 99.95
16K RAM (LANGUAGE CARD) ... 69.95
SPEECH CARD ... 75.00
COLOR MODULATOR KIT ... 19.95
POWER SUPPLY ... 119.95
DISK CONTROLLER CARD ... 69.95

### SPECIALTY INDUSTRIAL BOARDS FOR IBM COMPUTERS

SA-1206D ANALOG INPUT ... 495.00
SD-1203 ANALOG OUTPUT BOARD ... 535.00
SC-1602 A/D-D/A CARD ... 495.00
SI-3232 INDSUTRIAL CONTROL MODULE ... 549.95
SI-7210C IEEE 488 CARD (GPIB) ... 349.95
SI-8255 8255 I/O CARD ... 149.95
SI-8250 RS422 CARD 2ACTIVE PORT ... 119.95
SI-5124 FROM WRITER FOR 4EPROM ... 299.95

WE CARRY A LARGE SELECTION OF EMPROM WRITER, UNIVERSIAL PROGRAMMER, IC TESTER PAL, PROM PROGRAMMER (CALL FOR INFO.)
AB SWITCH BOXES SERIAL/PARALLEL, AUTO - OR MANUAL, WITH/ WITHOUT BUFFER FROM ... 39.95
GENDER CHANGER DB9/15/25 F/F/ M/M, CONVERTERS, BOOSTERS, MINITESTERS.

### LOCAL AREA NEWORK SYSTEM

UPS 110/210 ARCNET LANCARD ... 229.00
UPS 1000 ETHERNET LANCARD ... 349.00
UPS 400 4PORT ACTIVE HUB CARD ... 229.00
UPS 404 4PORT PASSIVE HUB CARD ... 59.95
UPS 808 8PORT ACTIVE HUB CARD ... 495.00
CALL FOR FULL INFORMATION.

### HIRES MONITORS

**GOLDSTAR**
4215 RGB ... 399.95
4095 EGA ... 499.95
1430 VGA ... 599.95
2115 12" AMBER SWIVEL BASE ... 139.95
2025 12" AMBER COMPOSITE ... 129.95
PACKARD BELL AMBER SWIVEL BASE ... 129.95

**TTX MONITORS**
1201A ... 12" COMP. AMBER MONOCHR. ... 129.95
1400F/A.14" TTL AMBER FLAT SCREEN ... 179.95
14S2F/W.14" VGA AN.WHT FL. SCREEN ... 199.95
2410 ... 14" RGB .43mm POL. TILT/SW ... 399.00
2410AG ... 14" RGB .43mm A.GL. TLT/SW ... 445.00
2411 ... 14" RGB .39mm POL.TILT/SW ... 475.00
2411AG ... 14" RGB. 39mm A.GL. TLT/SW ... 499.00
2412 ... 14" EGA .39mm A.GL.TLT/SW ... 575.00
2422 ... 14" EGA .31mm A.GL. TLT/SW ... 599.00
1435 ... 14" MULTI SYNC ... 850.00
1310 ... 14"ELECTROHOME M. SYNC ... 1099.00
1910 ... 19" ELECTROHOME M. SYNC ... 3250.00

**DATATRAIN MONITORS; COLOUR**
DC200S ... 14" .41mm DOT P. RGB T/S ... 449.95
DC205S ... 14" .52mm DOT P. RGB T/S ... 349.95
DC353S ... 14" .31mm D.P. EGA/CGA/T/S ... 549.95
DC355 ... DOT PITCH .41mm EGA/CGA ... 479.95
DC505 ... DOT PITCH .41mm VGA ... 499.00
DC600 ... M.RES VGA/DIG. D.P .31mm ... 679.95

**DATATRAIN MONITORS: MONOCHROME**
V240A ... 12" AMBER COMPOSITE ... 139.95
V242 ... 12" TTL AMBER OR GREEN ... 134.95
V252 ... 12" M.RES MONO AMB/GRN ... 149.95
V262A ... 12" FLAT SCREEN TTL AMBER ... 159.00
V272 ... 14" DUAL FREQ. AMBER/WHT ... 189.95
V282 ... 14" D. FREQ. FLT SCRN A/WH. ... 199.95
V502 ... 12" ANLG VGA/MCGA MONO WH. ... 199.95

### PRINTERS

**ROLAND PRINTERS**
RAVEN PR-9101 9 PIN AUTO ... 192 CPS ... 299.95
RAVEN PR-2417 24 PIN AUTO ... 192 CPS ... 549.95
RAVEN PR-9104 9 PIN AUTO ... 240 CPS ... 375.00
PR1012 ... 144CPS DOT MATRIX ... 249.95
PR1112 ... 192CPS DOT MATRIX ... 299.95
PR1212A, 219CPS DOT MATRIX ... 475.95
PR1250 ... 288CPS DOT MATRIX ... 549.95
PR1215 ... 216CPS WIDE CARRIGE ... 699.95
PR1550 ... 288CPS WIDE CARRIGE ... 799.95
PR2450 ... 240CPS WIDE CARRIGE ... 999.00
PR2017 ... 17CPS DAISY WHEEL ... 449.95

**EPSON 9 PIN DOT MATRIX PRINTERS**
LX-800 ... 180/150CPS DRFT30/25 NLQ ... 249.00
EX-1000 ... 250/45CPS DRFT/NLQ SL. TP ... 899.00
EX-800 ... 250/45CPS DRFT/NLQ SL. TP ... 699.00
FX-1050 ... 264/54CPS D/NLQ 132CL.SPK ... 899.00
FX-850 ... 265/54CPS D/NLQ SMARTPARK ... 650.00
FX-86E ... 200/40CPS D/NLQ 80 CLMN ... 549.00
24-PIN LETTER QUALITY DOT MATRIX PRINTERS
LQ-1050 ... 264/220/88/73CPS ... 1095.00
LQ-2500 ... 270/90CPS DRAFT/NLQ ... 1499.00
LQ-500 ... 180/60CPS DRAFT/NLQ ESC/P ... 575.00
LQ-850 ... 264/220/88/73CPS ... 895.00
DX-10 ... EPSON 10CPS DAISY WHEEL ... 349.00
SQ-2500 ... 540/180CPS DRAFT/NLQ -
STAR-24 NOZZLE INK JET 132 COL. ... 1495.00

**STAR PRINTERS**
NX-1000 ... 144CPS ... 289.00
NX-1000C ... 144CPS ... 289.00
NX-1000C ... 144CPS 7COLOUR ... 399.00
NX-1000 ... 144CPS 7COLOUR ... 399.00
NX-15 ... 120CPS ... 549.00
NR-10 ... 240CPS ... 599.00
NR-15 ... 240CPS ... 799.00
NX-2400 ... 170CPS ... 549.00
NB24-10 ... 216CPS ... 775.00
NB24-15 ... 216CPS ... 995.00
LASER PRINTER ... 2995.00

### ORION DISKETTES

**100% ERROR FREE & LIFETIME WARRANTY**

**ORION BRAND 5¼" DISKETTES**
0D2D ... 360K DS/DD ... $ 8.95
OD2HD ... 1.2M DS/HD ... $17.50
FOR COLOUR ADD ... $ 3.00

**ORION BRAND 3½" DISKETTES**
OF2DD ... 1M DS/DD ... $19.95
OF2HD ... 2M DS/HD ... $49.95
FOR COLOUR ADD ... $ 4.00

**NO NAME DISKETTES**
5½" DS/DD 360K ... $ 5.99
FOR COLOUR ADD ... $ 3.00
3½" 1M ... $17.50
FOR COLOUR ADD ... $ 4.00

FOR QUANTITY DISCOUNTS CALL.


**KAO®**

**KAO is for keeps**

KAO MD2D 5¼" 360K DS/DD ... 9.95
KAO MD2HD 5¼" 1.2M DS/HD ... 19.95
KAO COLOUR DISKETTES ADD ... 3.00
KAO MF2DD 3½" 1M DS/DD ... 22.50
KAO MF2HD 3½" 2M DS/HD ... 49.95
KAO COLOUR DISKETTES ADD ... 4.00
KAO DISCAROO 3½" IN POUCH ... 29.95

### ROLAND PLOTERS

DXY-980A ... B-SIZE ELECTROSTATIC ... 1995.00
DPX-2200 ... C-SIZE FLATBED ... 5750.00
DXP-3300 ... D-SIZE FLATBED ... 6995.00
DXY-1100 ... A/B SIZE 8 PEN ... 1349.00
DXY-1200 ... A/B SIZE ELECTROSTATIC ... 1749.00
DXY-1300 ... A/B SIZE 1M BUFF. STD. ... 2295.00
GRX-300 ... D-SIZE ROLLERBED ... 5995.00
GRX-400 ... E-SIZE ROLLERBED ... 7995.00

**ROLAND PLOTTER PENS**
WATER BASE ... 4/17.50
OIL BASE ... 4/19.50
CERAMIC BASE ... 4/34.95
IMAGE-TEC PLOTTER PENS
FIBER TIP ... 4/9.95
ROLLER BAL ... 4/17.50
PLOTTER PAPER ALL SIZES
UNINTERRUPTIBLE POWER SUPPLIES
UPS-250 SENDON ... 499.00
UPS-400 SENDON ... 599.00
UPS-800 SENDON ... 1299.00
POWER BAR WITH SURGE PROTECTOR ... 17.50
DD-100L HOLDS 100pc 5¼" WITH LOCK ... 12.50
DD-140L HOLDS 140pc 5¼" WITH LOCK ... 14.95
DD-80L HOLDS 80pc 3½" WITH LOCK ... 14.95

### ROLAND LAZER PRINTERS

CP 1100 11PGS/MIN ... 2995
1 MEG MEMORY EXPANSION CARD ... 599.00

WE CARRY ONE OF THE LARGEST SELECTION OF RIBBONS FOR ALL TYPES OF PRINTERS, SOFT WARE FOR IBM, APPLE, COMMODORE, ATARI ETC. BOOKS FROM MOST PUBLISHERS. CALL FOR A FREE FLYER & PRICING. COMPUTER CABLES FOR PRINTERS, MODEM, DISK DRIVES; CUSTOM MADE CABLES. CONNECTORS: DB SERIES, HEADERS, EDGE CARD, SEMICONDUCTORS, RAM, ROM, EPROM, TTL, CMOS, TUBES, CAPACITORS, RESISTORS, FUSES, CRYSTALS, TRANSISTORS, LAMPS, SWITCHES ETC. TEST INSTRUMENT, SCOPE, MULTI TESTERS, LOGIC PROBES ETC. ELECTRONIC KITS, EDUCATION / HOBBYIST. MOVING SIGN ANY SIZE.

CALL US FOR YOUR ELECTRONIC NEEDS!

**MOST ORDERS SHIPPED WITHIN 24 HOURS.** | **SERVING YOU FOR OVER 15 YEARS** | **If you find a better price call us before you buy.**

### TERMS

VISA/MC/COD/CHEQUE
ALL ITEMS SHIPPED BY CANPAR OR MAIL, ADD $4.00 FOR ALL COD ORDERS. ALLOW 10 BUSINESS DAYS FOR SHIPPING WHEN PAYING BY PERSONAL CHEQUE. ALL ITEMS SUBJECT TO PRIOR SALE DELIVERY & HANDLING CHARGE 6%, MIN. $5.00. ALL RETURNED MERCHANDISE MUST HAVE RMA NUMBER. RESTOCKING CHARGE 20%. PRICE SUBJECT TO CHARGE WITHOUT ANY NOTICE.

Credit card charges are not submitted until time of shipment

MasterCard | VISA

WHY WAIT? CALL ORION ELECTRONICS NOW!

ORDER TOLL FREE!

# 1-800-265-2658

40 LANCASTER ST., W. KITCHENER, ONT. N2H 4S9
PH: (519) 576-9902 FAX: (519) 576-9028

FOR IMMEDIATE ACTION USE OUR FAX

Order desk & technical support open:
9:00 a.m. to 6:00 p.m. Monday-Friday
9:00 a.m. to 5:00 p.m. Saturday

**For Service CALL 1-519-576-9026**

Immediate shipment on purchase orders from qualified institutions (schools and universities included).

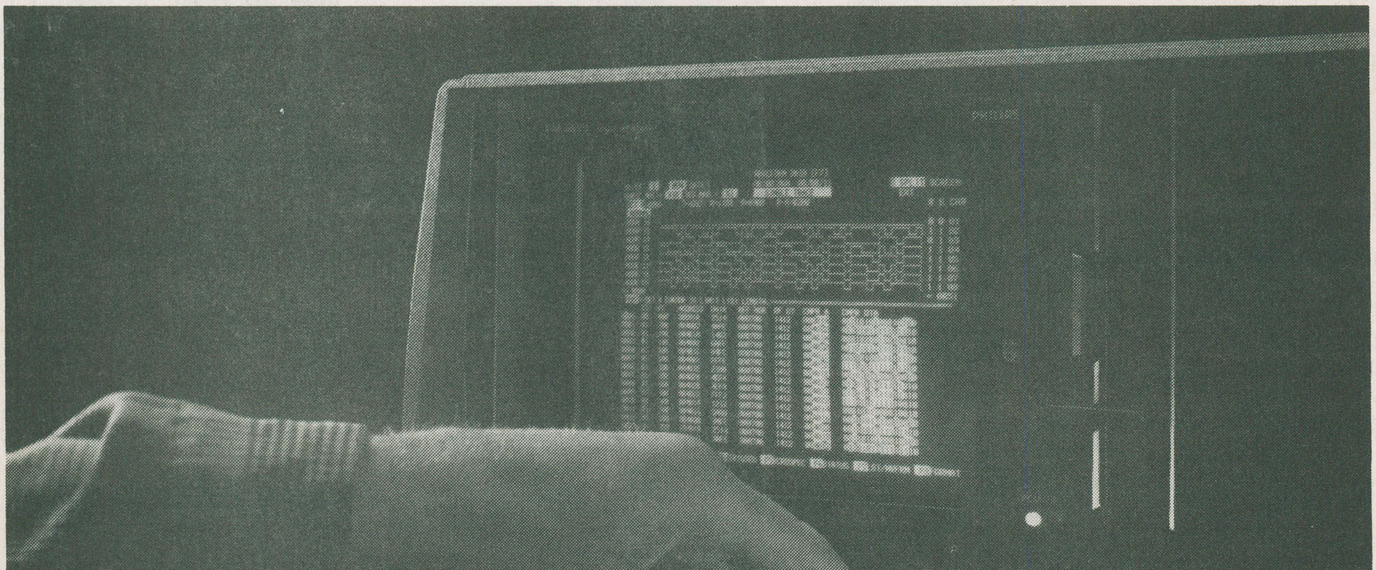
DEALER INQUIRIES INVITED

Circle No. 10 on Reader Service Card

# Using a PC-Based Logic Analyzer

**An alternative to the use of automated test equipment.**

ROBERT ROTH



Using automated test equipment (ATE) ensures that a new product is fully and efficiently tested. However, large-scale ATE is not practical for every new product. For low-volume products incorporating custom components, the manufacturer can rarely justify the high start-up costs of expensive ATE systems. In addition, traditional ATE may miss real-time problems in those products with custom or high speed components. In cases like these, engineers and technicians often rely on the logic analyzer — a low-cost alternative to ATE that can help them isolate faults quickly.

## Manual Testing Takes Time

Even with a logic analyzer, testing can often be a labor- intensive task. For example, if a product is complex and the technician is unfamiliar with the product, he may first have to spend several hours poring over schematics. Or, if the operator needs to verify the operation of a newly assembled product, the major functional sections of circuitry have to be tested and that can take considerable time. In cases where the product uses a standard or common microprocessor supported by an emulative tester like Fluke 9010/9100, the functional testing process is automatically provided, and the logic analyzer is a good complement.

But if you equip a logic analyzer with personal computer-based control functions, you can reduce testing demands for products with custom components to an automated procedure. Using macros or batch files, the MS-DOS personal computer (PC) can automate the logic analyzer, speeding up and simplifying what might otherwise be a lengthy step-by-step troubleshooting procedure.

Various combinations of PCs and logic analyzers exist: PC with built-in logic analyzer board, logic analyzer with built-in PC, or logic analyzer and stand-alone PC that communicate over a standard bus (for example, IEEE-488). The set-up you choose can dramatically affect both the system's speed and the labor required to automate the system. Systems comprising a logic analyzer integrated with an MS-DOS PC provide two advantages: they can quickly access data files, and they can automatically step through set-ups without lengthy, time-consuming IEEE-488 bus transfers and without difficult programming.

## Automating With Macros

By using standard MS-DOS commands, you can create macros that automate repetitive logic analyzer functions. Let's look at the PM 3655 logic analyzer from Philips, a full-featured logic analyzer and MS-DOS personal computer in a single unit (see Photo 1). The PM 3655 comes standard with 2 Kbits per channel of logic analyzer memory, 256 Kbytes of RAM and a 360-Kbyte floppy disk drive, allowing it to support MS-DOS applications and file storage. With options the system resources

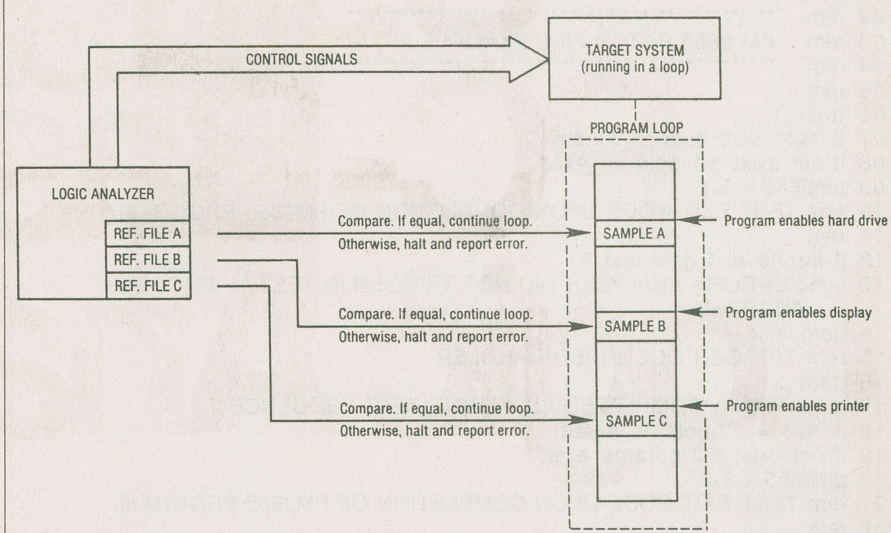



*Fig. 1. You can write a macro to check different functional blocks in your target system when each is activated by the software. For example, the macro could check communications with the hard drive, display and printer.*

```
A>copy getdir+inc+dn+lf+up+cr+up+up+up+up+up+up+up load
A>copy load+up+up+up+up+dn+dn+dn+inc+arm+1sec getdata
A>copy getdata+print+inc+print+dec sect1
A>copy sect1+dn+dn+pgup+up+up+lf+print+inc+print+dec sect2
A>copy sect2+dn+dn+pgup+up+up+lf+print+inc+print+dec sect3
A>copy sect3+dn+dn+pgup+up+up+lf+print+inc+print final
A>copy final+f9 prntout.mcr
A>pm3655 < prntout.mcr
```

*Fig. 2. This simple macro controls data acquisition from the target system and prints the entire contents of the logic analyzer's memory.*

```
echo off
rem     ***********************************************
rem     PM 3655 BATCH FILE EXAMPLE 2
rem     ***********************************************
rem
:test_1
if "%1" == "" goto no_param
if not exist %1 goto no_exist
pm3655 < %1
rem TEST EXIT CODE UPON COMPLETION OF PM3655 PROGRAM
rem
if errorlevel 1 goto test_2
echo ERROR - ANALYZER DID NOT TRIGGER IN TEST 1 - PROCESS
     ABORTED
goto exit
rem TRIGGER OCCURRED HANDLER
:test_2
echo TEST 1 COMPLETED - STARTING TEST SEQUENCE 2
if "%2" == "" goto no_param
if not exist %2 goto no_exist
pm3655 < %2
rem TEST EXIT CODE UPON COMPLETION OF PM3655 PROGRAM
rem
if errorlevel 1 goto test_3
echo ERROR - ANALYZER DID NOT TRIGGER IN TEST 2 - PROCESS
     ABORTED
goto exit
rem TRIGGER OCCURRED HANDLER
:test_3
echo TEST 2 COMPLETED - STARTING TEST SEQUENCE 3
if "%3" == "" goto no_param
if not exist %3 goto no_exist
pm3655 < %3
rem TEST EXIT CODE UPON COMPLETION OF PM3655 PROGRAM
rem
if errorlevel 1 goto end
echo ERROR - ANALYZER DID NOT TRIGGER IN TEST 2 - PROCESS
     ABORTED
goto exit
rem TRIGGER OCCURRED HANDLER
:end
echo ALL TESTS COMPLETED - END OF SEQUENCE
goto exit
rem     ***********************************************
rem     ERROR HANDLER FOR NO PARAMETER PASSED
rem     ***********************************************
:no_param
echo ERROR - YOU MUST SUPPLY A MACRO FILENAME WHEN RUNNING
     THIS PROGRAM
goto exit
rem     ***********************************************
rem     ERROR HANDLER FOR NON EXISTING MACRO FILE
rem     ***********************************************
:no_exist
echo ERROR - YOU MUST SUPPLY AN EXISTING MACRO FILE
echo EXISTING MACRO FILES IN CURRENT DIRECTORY ARE: dir *.mcr/w
goto exit
rem     ***********************************************
rem     PROGRAM EXIT POINT
rem     ***********************************************
:exit
```

*. This batch file executes three macros sequentially and sends error messages to the monitor.*

can expand to 640 Kbytes of RAM and a 40-Mbyte hard disk.

One way to automate testing with a PC-based logic analyzer is to write a simple macro that automates repetitive tasks by storing keystrokes in a file that will "press the keys" automatically under MS-DOS. Figure 1 gives an example: A macro allows the logic analyzer to automatically check three functional blocks – hard drive, display and printer – when each is activated by software.

## Figure 1

Before the macro runs, the appropriate reference files must be stored in the default disk drive. The macro enables the logic analyzer, which is set to trigger when the control programs for each of the three hardware elements are running. Test 1 compares the acquired file with the reference file 1; if the two files match, the macro continues to run until the second trigger point is reached. If the two do not match, the macro stops and alerts the operator. Since the macro is interactive, the operator can take the appropriate corrective steps and restart the macro at any point. After all three file comparisons have been made, the macro stops and returns the logic analyzer to the Ready mode.

Some PC-based logic analyzers can automatically store data to disk when they detect a mismatch between acquired and reference data, which enables you to further analyze the data. For example, a unit with a compare feature can continually monitor data and store a mismatch. From the stored data you can use post- processing software for further analysis. Moreover, since you have automated and stored your entire test, you can distribute the test on a diskette to your field service offices. To make the test almost foolproof, you can also include set-up information like hardware connections and key sequences.

## Writing Keyboard Macros

First, we'll look at the process of creating macro files that automate data acquisition and analysis. Later, we'll discuss DOS batch files that allow you to design more extensive commands.

DOS allows you to redirect both input to and output from a program. The keyboard is the standard device for input, and the display is the standard device for output. By using DOS redirection, you can redirect the output to a disk drive for permanent data storage, and you can redirect input so that the logic analyzer acknowledges a disk file as its input source. Exploiting this redirection capability allows you to

automate repetitive tasks. You can store keyboard macros on hard disk, redirect DOS to acknowledge the hard disk drive as its input source, execute a macro, and redirect the output to the designated location – for example, a printer.

Macros are easy to write with the aid of the DOS copy command, which allows you to concatenate files using the plus sign (+). You can also create macros that include other macros. Alternately, you can write macros on a word processor; however, your file must be stored on disk in the DOS text-output format, not in the standard format of the word processor. Most of the latest word processors can export data in the DOS text format.

As an example of how effectively a macro can turn a laborious task into a few simple keystrokes, let's look at a macro that records data from a target system and prints the entire memory without operator intervention. The macro controls every step of the process, including: 1) loading set-up parameters for the target system, 2) initiating data acquisition from the target system, 3) storing the data, 4) printing the entire contents of memory, and 5) returning the system to DOS.

### Figure 2

The macro in Figure 2 is written for a 48-channel PM 3655 logic analyzer, with an Epson or Epson-compatible dot matrix printer connected. Note that the macro contains a number of cursor- positioning keystrokes (up, down, and page up). The purpose of these keystrokes is to ensure that the cursor is in the right position to reach particular fields.

Since macros are written entirely within MS-DOS, you can write your macros on any MS-DOS personal computer. Doing so allows you to develop your automated tests off-line, thereby freeing the logic analyzer for other purposes. However, you need to be careful if your target analyzer configuration is different from the default settings used by the logic analyzer; if it is, take that fact into account when writing macros.

## Writing Batch Files for Increased Automation

Although keyboard macros automate a variety of routine procedures, each call to the logic analyzer's program accomplishes only one task. If you need to perform a series of tasks or rely on conditional program execution, you can combine multiple logic analyzer program calls into a single DOS batch file. Doing so also allows

*Continued on page 52*

# USING YOUR LOGIC ANALYZER AS "PROTOTYPE ATE"

Because a good logic analyzer is adept at isolating errors, it is often used when something goes wrong during the design stage. However, the logic analyzer can also automate testing of pre- production runs or small, regular production runs where circuitry is fast and complex. Moreover, it can isolate batch production problems. You can use the logic analyzer as "prototype ATE" to test your design at incremental stages of the product life cycle.

Why is the logic analyzer so useful throughout the life cycle of many products? Two reasons: 1) The logic analyzer give a complete picture of circuit operation, with enough information to solve the most difficult problems, and 2) For designs incorporating microprocessors not supported by low-cost emulative testers, the logic analyzer offers automation without the high initial investment of ATE.

One of the shortcuts possible today is to use a logic analyzer with a built-in PC, as this article suggests. Just as spreadsheet programs automate many financial and database projects, MS-DOS programs and utilities can be used to develop prototype ATE software to analyze digital data acquired by a logic analyzer. By "pasting together" application programs such as Lotus 1- 2-3 and Asystant, and combining them with MS-DOS utilities such as the time-of-day function and batch files, you can quickly develop prototype ATE. It may not be as efficient, comprehensive, or fast as an ATE system in the $1 million range, but it can be extremely cost-effective in uncovering problems or monitoring a production process.

In some cases, a PC-based logic analyzer serving as prototype ATE is also the best choice for "final ATE"; that is, the ATE set-up you will establish for your final released product. Why? One reason is that many of the newer designs incorporate components that make testing with traditional, large-scale ATE impractical. For example, high-speed RISC-based designs running at 100MHz are too fast for common ATE set-ups.

Furthermore, custom chips, DSP (digital signal processing) chips, and ASICs (application-specific integrated circuits) have created products that are difficult to test. These highly integrated parts sometimes package a microcontroller, RAM, I/O circuitry, digital-to-analog circuitry, and analog-to-digital circuitry all on one chip. What's more, such a unique part won't be found in the ATE's system's software library. A sophisticated logic analyzer can monitor up to 100 channels simultaneously and offers resolution of 100MHz; such a tool can keep watch over the complex communications and speeds in today's designs.

Given the complexity of today's boards and the low-cost automation possible on today's high-performance logic analyzers, no longer is the logic analyzer just a tool to fire up when something goes wrong. It is just as adept at keeping complex designs running throughout a product's life cycle.

# Advertisers' Index

## August 1989





# Using a PC-Based Logic Analyzer

*Continued from page 50*

you to further process captured data with other DOS programs.

When you create a DOS batch file, you benefit from several features that can make your automated test programs more effective. For example:

**Parameter Passing.** This standard DOS feature allows you to pass variables from the command line to the batch file for conditional execution.

**Chaining.** You can connect, or "chain", separate batch files to execute an entire series of tests. With chaining you avoid having to write long and complex monolithic files.

Batch Processing Commands. Using batch files opens up additional possibilities for conditional batch processing. For example, batch files give you access to the GOTO, IF, and FOR commands.

The batch file in Figure 3 executes three macros, aborts if any test fails, and displays the number of the failing tests on the screen. Because the batch file exits the logic analyzer program upon entry and exit, only the last message remains on the screen. If you want to store all messages upon exiting the program, you can modify the batch file so that it stores all messages in a file on disk.

## Figure 3

Before invoking the batch file, be sure that a target-specific set-up file exists and that the individual macros function correctly. Note also that, if the three macros are specified on the command line, the same batch file can be used with different target systems.

## Using Post-Processors

The techniques we have discussed so far provide examples of on- line data analysis. A logic analyzer that provides permanent storage, preferably on either floppy disk or hard disk, affords you another option: the data can be saved for off-line processing. Several options in post-processing software are available. One broad classification, signal-processing software, consists of packages that process an output signal and correlate it with the corresponding input to verify the performance of a circuit or a component. For example, packages such as Asyst (Asyst Technologies, Inc., Rochester, NY) can perform a Fast Fournier Transformation (FFT) on a digital output and compare it with the analog input to verify the performance of an A-D converter.

The other broad classification of post-processing software contains general-purpose products such as Lotus 1-2-3 or Symphony. Using these or similar programs, you can present acquired data graphically to view the characteristics of a waveform. Of course, since such programs are not customized for signal processing applications, you'll have to understand how your logic analyzer stores acquired data and how to convert the data into the correct form for graphic presentation.

## Integrating Logic Analyzer and PC Eliminates Interfacing Problems

Although macros and DOS batch files can greatly simplify the measurement process, be sure that this increased simplicity does not come at the expense of an unmanageable interface. If you choose the integrated architecture of instruments such as the Philips PM 3655, the interface is transparent because it's an essential aspect of the system design. With such an instrument, automating the measurement function requires only that you understand specific MS-DOS functions.

On the other hand, if you connect a stand-alone logic analyzer and a stand-alone PC, you'll need to decide which bus structure to use. Will you use an IEEE-488 bus or another architecture? Whichever way you go, you'll need to understand the structure of the bus. Moreover, you'll have to write specialized control programs (typically in BASIC or C) to control the communication between the two units. Connecting stand-alone units also causes a slowdown in overall system operation. The control program adds to the complexity of the interface, and access times increase due to the communication over the bus.

In short, when you're setting up your system, be sure to consider system architecture carefully. A logic analyzer that incorporates a PC eliminates concerns over interfacing. No programming and no additional equipment are required to set up the interface, and you don't suffer the complications presented by a customized interface.

## Summing Up

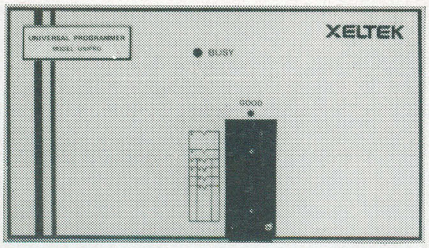
When standard ATE does not address the test requirements for high speed or custom design, a PC-based logic analyzer provides the automated testing capabilities that you expect in well-designed ATE. Whether you need to analyze acquired data on-line or store and retrieve data for further post-processing, the personal computer and logic analyzer make an excellent combination.

*Robert Roth is the Product Marketing Manager for logic analyzers, Philips Test and Measurement Group, John Fluke Manufacturing Co., Inc.* ■

# THE QUALITY LINE

## UNIVERSAL PROGRAMMER for PC/XT/AT

### XELTEK UNIPRO




Programs:
- EPROMS (to 1 Mbit)
- Bipolars
- PALs & FPLDs
- 8748/8751

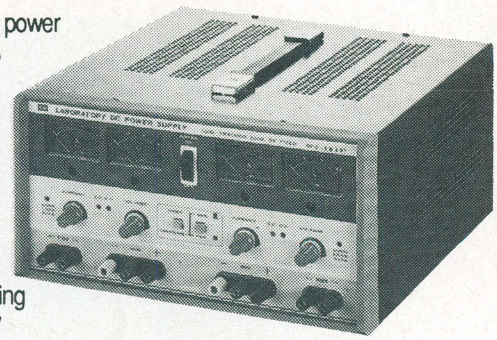
Tests:
- TTL/CMOS Devices
- Memory Devices

**Circle No. 70 on Reader Service Card**

## DC POWER SUPPLIES

### GW INSTRUMENTS — GP SERIES

Over twenty quality power supplies for the lab, classroom or production line.



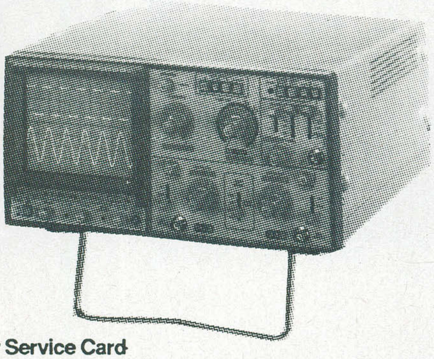
- Single, Dual or Quad output
- Dual-tracking Volts/Amps. (GPD/GPQ) 0-60V./0-10A
- Analogue metering or Digital display
- Regulation 0.01% typical

**Circle No. 71 on Reader Service Card**

## DUAL TRACE OSCILLOSCOPES

### GW INSTRUMENTS — GOS SERIES

For performance and reliability.



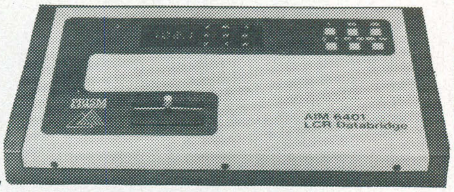
- Select from five models.
- Dual or single trace.
- Bandwidth: 40, 20 MHz.
- Triggered/Delayed sweep operation.
- Sensitivity to 1 mV.

**Circle No. 71 on Reader Service Card**

## AUTOMATIC LCR BRIDGE

### PRISM ELECTRONICS — MODEL 6401

Features:



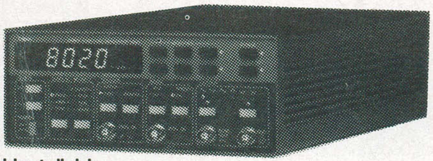

- Measure R, L, C, and Q automatically
- Eight decades of LCR measurement
- Series or parallel measurement modes
- Four digit LED display
- Basic accuracy; 0.25% of reading

**Circle No. 72 on Reader Service Card**

## 20 MHz FUNCTION GENERATORS

### TABOR ELECTRONICS — SERIES 8020

| Choose from: | Model |
|---|---|
| Standard | 8020 |
| Pulse/Function | 8021 |
| AM/Function | 8022 |



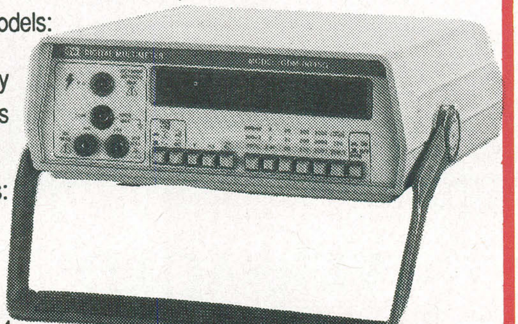

Product Highlights:
- GPIB - Interface - Field Installable
- 30 Front Panel Set-ups backed by non-volatile memory
- Amplitude 10mV to 30Vp-p
- Frequency 2 mHz to 20 MHz
- Pulse Width 25 nS to 9.99S

**Circle No. 73 on Reader Service Card**

## DIGITAL MULTIMETERS

### GW INSTRUMENTS — GDM SERIES

Rugged and reliable—for the lab, field or production line.



- Select from four models: 3 1/2 or 4 1/2 digit LED or LCD display
- Standard Functions (AC/DC Volts/Amps & Resistance) plus: Diode check, Continuity Test, Capacitance 1.99 nF to 19.99 uF GDM8034
- Accuracy: to 0.03% (TRMS) GDM8045; to 0.1% DCV GDM8035.

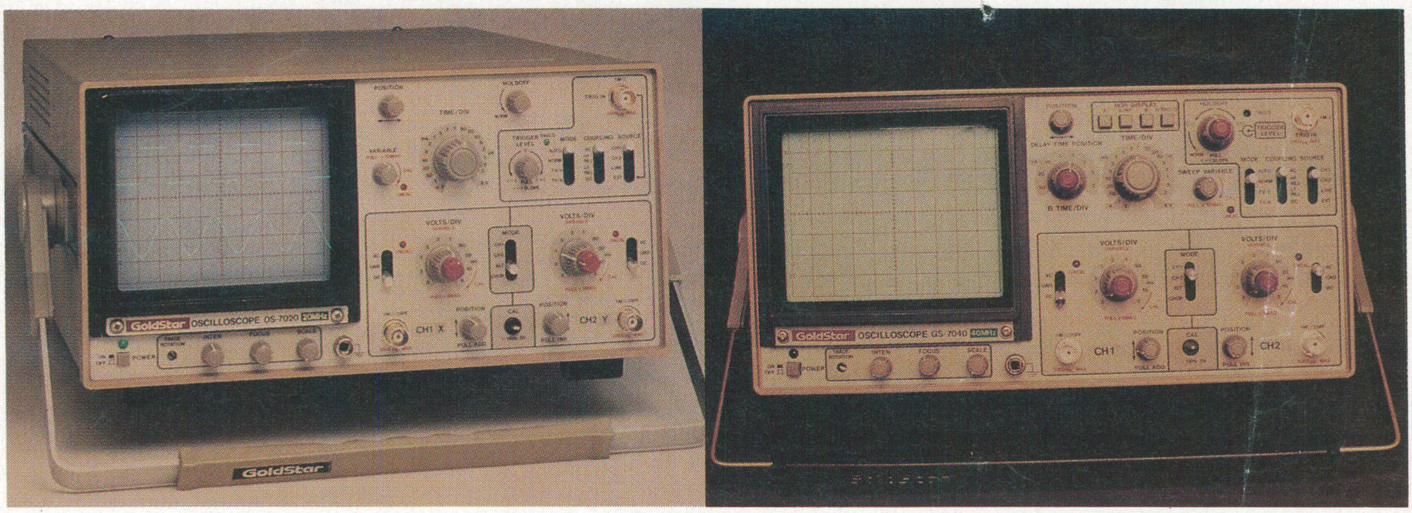
**Circle No. 71 on Reader Service Card**

GW INSTRUMENTS are available through stocking distributors.

## DUNCAN INSTRUMENTS CANADA LTD.

ELECTRONIC INSTRUMENT SPECIALISTS

121 MILVAN DRIVE, WESTON (TORONTO), ONTARIO M9L 1Z8
TELEPHONE: (416) 742-4448 FAX: (416) 749-5053




# When was the last time the oscilloscope that appealed to the engineer also appealed to the accountant?

The trouble with most quality oscilloscopes is their bottom line. In fact, they're downright expensive. And historically, people who've had a limited equipment budget have had to settle for second best, sacrificing quality for price.

But the OS-7020 and OS-7040 oscilloscopes have changed all that. Made by Goldstar, they're technically brilliant and mechanically superb products exemplifying the best in craftsmanship. Yet, incredibly, they cost only a fraction of comparable instruments on the market today.

The OS-7020 and OS-7040 clearly displays colour burst for immediate evaluation. Inbuilt delay line (OS-7040). Adjustable hold off. And ultrahigh trace definition even with signals of short risetime and low repetition rates. Both scopes include Z axis inputs, channel 1 vertical amplifier outputs, CRT graticule illumination, 5 MV sensitivity for the specified bandwidth and a X5 gain switch for increased sensitivity of 1 millivolt with reduced frequency response. Qty. 2 switchable 10:1 1:1 oscilloscope probes are supplied as standard accessories.

Naturally, you'd expect oscilloscopes with such an impressive list of features to have an impressive list of applications. And they do. The Goldstar range of oscilloscopes is ideal for broadcasters, research and development, video recorder servicing, education, cable operators, TVRO satellite video communications, military and professional CCTV and fibre optic applications.

The news, however, gets even better. Once you purchase a Goldstar oscilloscope, you're not left up to your own devices. Each instrument comes with a genuine three year unconditional guarantee. Plus service and immediate parts availability from Tradeport.

For more information and a copy of the complete Goldstar catalog, write using the reader service card in this magazine.

**Circle No. 50 on Reader Service Card.**

## TRADEPORT ELECTRONICS GROUP

**HEAD OFFICE: 220 WILDCAT ROAD, DOWNSVIEW, ONTARIO, CANADA M3J 2N5**
**TEL: (416) 736-0866 FAX: (416) 736-9102**
***DEALER INQUIRIES INVITED***

# For any point of view


## Panasonic® Industrial Cameras

No matter what needs to be seen. From the most hard to get at places to the most hostile environments. Whatever application you specialize in, Panasonic has a special camera to see any point of view.

For applications that require highly accurate color, Panasonic color cameras are right up to spec. Take the GP-CD1, it's ideal whenever small size is a big concern because it's less than 2″ long and weighs less than an ounce. So it can go places and show you angles other cameras can't.

The GP-CD110A, like its smaller counterpart, employs a charged coupled device for high resolution and high resistance to burn-in and lag. And for accurate color under a wide variety of lighting conditions, both color cameras have auto-tracing white balance.

When it comes to any image processing system where small size and low weight are a must, size-up the GP-CD55 black and white CCD camera. You'll find it perfectly suited.

When the action is fast, Panasonic has what it takes to capture it. In fact, with a shutter speed of 1/1000 of a second, the GP-CD40 is your clear choice for high quality images.

The GP-CD60 is a natural when it comes to pattern recognition and machine vision. Because it has a TSL MOS image sensor and includes an electronic focal plane shutter, electronically variable sensitivity and selectable scanning.

Adding to our impressive line-up of solid state cameras, is the kind of engineering and service support you expect from Panasonic. By now it should be easy to see. No matter what your point of view, all you have to do is look to Panasonic.

For more information call Jay Ward at (416) 238-2268 or contact:
Panasonic Industrial Video Dept.
Matsushita Electric of Canada Ltd.
5770 Ambler Dr.,
Mississauga, Ont. L4T 2T3
(416) 624-5010

**Panasonic**
Industrial Products Division
The Perfectionists

Circle No. 11 on Reader Service